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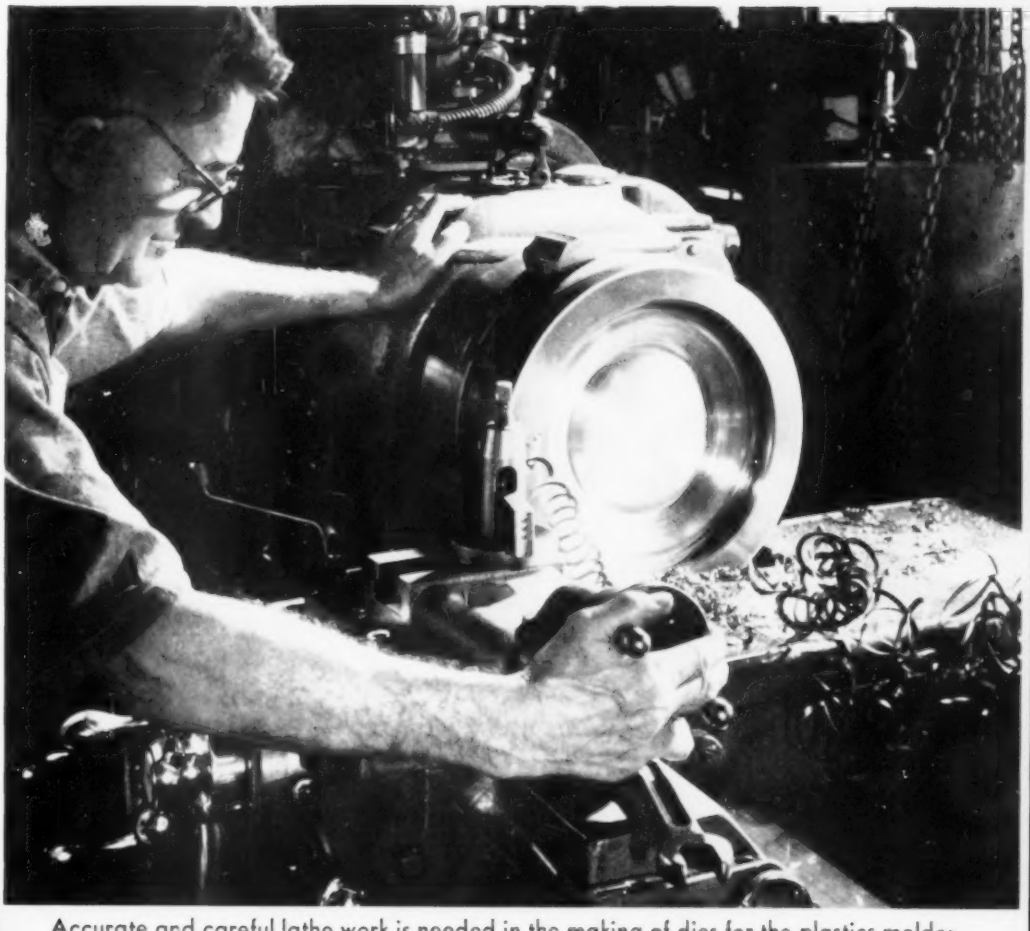

Accurate and careful lathe work is needed in the making of dies for the plastics molder.
(Photo courtesy of Newark Die Co.)

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.

How **Beetle**® control housings help sell electric blankets

COLOR SELLS . . . Blending beautifully with blanket colors, these new thermostat control housings are molded of Cyanamid's BEETLE urea-formaldehyde molding material in warm, glowing pastel shades. BEETLE offers you an unlimited range of permanent, through-and-through colors . . . a valuable sales *plus*.

MINIMUM UPKEEP SELLS . . . Because BEETLE doesn't attract dust, it stays *cleaner*. A thermosetting plastic, BEETLE has a hard, smooth, wear-proof surface—easy to keep free of finger marks.

DESIGN SELLS . . . Leading designers and top-flight engineers agree that BEETLE molds readily into smart, functional modern shapes. These housings, by Monte Levin, noted industrial designer, combine good lines with the quality look and feel of BEETLE.

Want to improve the "housing conditions" of your product? BEETLE has the working properties you need, plus sales-appeal. We'll be glad to work with you.

AMERICAN Cyanamid COMPANY

PLASTICS AND RESINS DIVISION

32-D Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto & Montreal

SPE JOURNAL

VOL. 10 November, 1954 No. 9

Published monthly except July and August by

THE SOCIETY OF PLASTICS ENGINEERS, INC.

30 cents a copy $3.00 per year

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JESSE H. DAY, Editor

This is Chalfonte-Haddon Hotel in Atlantic City, where the Eleventh Annual SPE Technical Conference will be held January 19-21, 1955

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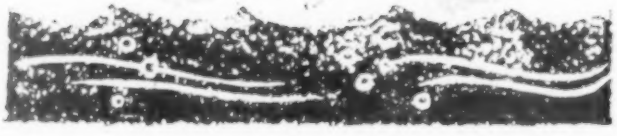
Here's the phenolic that makes

HEAT and MOISTURE

easy to handle

DUREZ 13856



WHEN SPECIFICATIONS require a material resistant to heat and moisture in combination and to alkalies such as soap and detergent solutions, Durez 13856 Black has the properties you want. This one-step flock-filled phenolic is especially suited for such applications as the following:

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In a room humidifier for example, motor heat on one side and moisture on the other do not affect parts of Durez 13856 adversely. The material has good flow and high dimensional stability, while its impact strength qualifies it further for these applications.

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DUREZ

PHENOLIC RESINS — MOLDING COMPOUNDS; INDUSTRIAL RESINS; PROTECTIVE COATING RESINS

[PHENOLIC PLASTICS THAT FIT TODAY'S PRODUCTS
for the new era of competition]

Book Reviews . . . .

SUCCESSFUL COMMERCIAL CHEMICAL DEVELOPMENT, H. M. Corley, editor; published by John Wiley and Sons, Inc., New York. 374 pages, price $7.75

The main problem faced by any manufacturer is the development and effective marketing of new products. While this book is aimed at chemical producers, it applies with full force to all manufacturers. The purpose of the book is—"documentation of the important principles that govern each essential step in the selection and development of promising new [products]"—.

An idea of the scope of material concerned is provided by the chapter headings:

The Need, Growth, Results, and Objectives of Organized Commercial Development; The Scope of Chemical and Marketing Research Group Activity in Commercial Chemical Development; Commercial Chemical Development Contributions of Other Corporation Groups; External Sources of Commercial Chemical Development Aid; The Management of Commercial Chemical Development; The Origin and Handling of New Product Ideas; The Selection and Continued Evaluation of New Product Projects Development and Semi-Work Stages; New Product Project Objectives Preceding the Process Development Stage; New Product Project Objectives in the Semi-Work Stage; New Product Project Objectives While Awaiting Full Scale; Sampling and Tradenames; New Product Advertising; New Product Pricing; Product Labeling, Packaging, and Shipping Considerations; Toxicology, Safety, Handling; Formulated Products and Special Problems of Developing Successful Retail Items; Selected Case Histories of New

(please turn to page 6)

CAN YOU AFFORD ANYTHING LESS THAN BEST?

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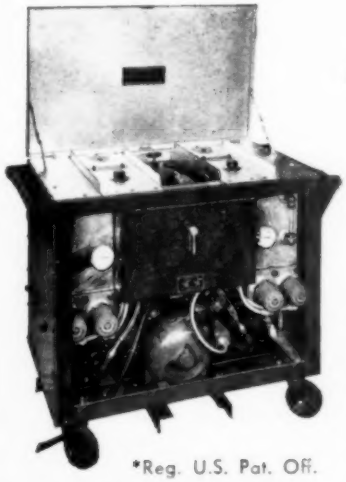

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Across the Editor's Desk . . . .

• Art Ingozzo just sent us a copy of a ten page booklet bound in heavy paper cover that's been published by the Eastern New England section. Attractively designed, each page describes one of the meetings for the year, with photos of speakers and abstracts of the talks. A roster of members fills the end pages, and photos of the officers are on the first pages. The idea is a fine one, and the fellows responsible deserve a pat on the back.

A number of other sections also print up the year's program in advance, and many also have local monthly news publications that are very interesting. Newark's "What's New?" gives news items, runs an employment clearing house, and publishes names of new members. Philadelphia has a similar publication. If **your** section has a program made up for the year, send it in to the Journal and we'll be glad to print it.

• Like to read? The SPE Journal needs several book reviewers—one an expert in plastics molding, one in reinforced and structural plastics, and one in plastics chemistry. No pay, but you can keep the book! Write to J. H. Day, Ohio University, Athens, Ohio, and tell me how many books a year you can handle and what subjects you want to review.

• We are always glad to hear from our old friend Herb Spencer, and doubly so when he has something nice to say. So it is with pleasure that we reprint his letter here.

Dear Sir:

It was satisfactory to read in Mr. Colby's report of the Philadelphia meeting reference to SPI President John O'Connell's suggestion that a custom molder concentrate his sales effort to a radius of 250 miles.

It has always been my belief that the custom molder would profit by systematically concentrating on an area he could adequately cover.

Now, such a program should include taking advantage of all opportunities that would make the molder and his organization the predominating plastics men in the area.

Obviously, a systematic listing and a study of prospects would be the first thing on the program. Beyond this and direct sales calls, the work should be supported by letters or bulletins, advertising in the local Chamber of Commerce publication and Service Club bulletins, and talks before these clubs and other groups.

It would be very worthwhile to approach manufacturers who are logical prospects and offer to discuss the subject of plastics with their personnel, for most organizations have committees, management group gatherings, meetings of their engineering staff, etc., and invariably welcome speakers.

The No. 1 purpose is, of course, to secure business, but toward this end these supports to direct sales solicitation will build a reputation with the result that the individual and his organization will be known as the plastics men in the home area.

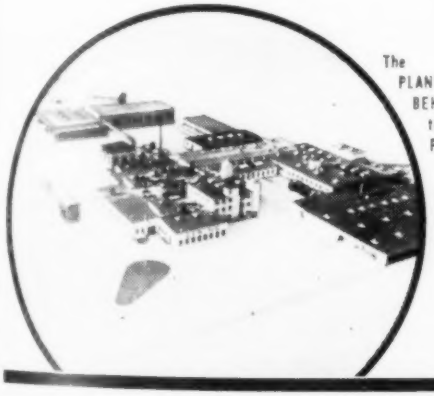
Beyond this effort, of course, there is the broader

(please turn to page 6)

GERING ····· MOLDING POWDERS ··· for GREATER PRODUCTION

CUSTOM COMPOUNDING OF *all plastics*

If your facilities are crowded, or your THERMOPLASTIC products require special processing techniques, it will pay you to talk to GERING before investing in production machinery.



The PLANT BEHIND the PRODUCT

WE are completely staffed with Laboratory, Technical and Engineering personnel; and equipped with BANBURY MIXERS — MILLS — EXTRUDERS — GRINDERS — PELLETIZERS — BLENDERS — BAGGERS and MATERIALS HANDLING EQUIPMENT to produce under your label large quantities of molding and extrusion compounds in any formulation of all thermoplastics, including POLYETHYLENE, VINYLS, NYLON, ACRYLIC, CELLULOSE ACETATE, BUTYRATE, ETHYL CELLULOSE, POLYSTYRENE and its COPOLYMERS.

. . . and behind our plant, equipment, production and personnel are 31 years of learning HOW.

GERING *Products • Inc.*
KENILWORTH, N. J.

Conversion Specialists • Plastics Raw Materials
"PIONEERS IN MODERN PLASTICS FOR OVER 30 YEARS"

Across the Editor's Desk . . . .

(continued from page 5)

aspect that should not be neglected. Also, the practicability of specializing in a definite industry.

So, having preached this theory for a good many years, it was interesting and satisfactory to see that others are thinking along the same line.

Cordially yours,
H. S. Spencer
Durez Plastics & Chemicals, Inc.

Book Reviews . . . .

(continued from page 4)

Product Developments; Some of the More Important Qualifications for Commercial Chemical Development Work; Index.

The book was written for the Commercial Chemical Development Association by a number of its committees, and the whole edited by H. M. Corley, Director of Market Development for New Chemicals, Armour and Co. It was five years in the writing.

We recognize a number of old friends and SPE members among the authors, such as Clayton Ruebensaal and Russ Akin. If these men mark the caliber of the other authors, then it is authoritative and up-to-the-minute throughout.

The book is more than usually lucid, detailed and interesting to read. It is heartily recommended for all those men who are responsible to their companies for the development of new products and their effective presentation to the market.

Silk-Screening
PLASTIC decorating
Off-Set Printing
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Moulders and Fabricators requiring trade marking and decorating on plastic products.

The above three processes are applicable on all types of plastic such as nylon, polystyrene, polyethylene, acetate, vinylite, acrylics, bakelite, cast resins and fibre.

Our facilities are the largest in the country and we contract to do any marking required regardless of quantity, shape or size.

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2 NEW High-Gloss Improved Impact BAKELITE Styrenes

TRADE-MARK

1 TGD-5001 for extrusion into sheets for subsequent postforming

2 TMD-5151 for injection molding

These compounds are the result of an extensive research and development program aimed at producing impact styrene materials superior to any hitherto available to industry.

TGD-5001 features

- Permanent high gloss on leaving the extrusion die with no post-planishing necessary. Gloss is retained during postforming operations, particularly deep draws.
- Excellent heat stability — can be repeatedly recycled in the extruder without discoloring.
- Superior extrudability; close thickness tolerances easily maintained.
- Superior toughness.
- Ease in vacuum forming, permitting undercuts and more complex mold designs, without danger of cracking or breaking on release.

Large door panel for freezer is vacuum formed from TGD-5001. High impact strength of material is important to this application.

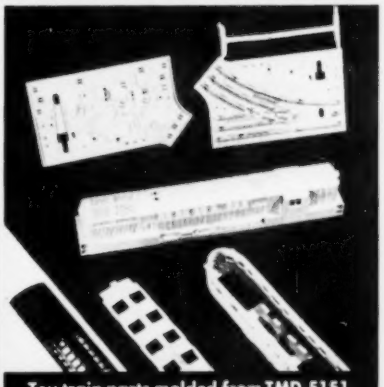
Display stand vacuum formed from extruded sheet of TGD-5001 demonstrates deep-drawing and deep undercuts possible with this material.

TMD-5151 features

- Impact strength 8* times that of general-purpose styrenes.
- Fast setup reducing molding cycles as much as 10 per cent compared with that for previous materials.
- High plasticities providing easy flow into all parts of mold, giving perfect detail with intricate designs.
- Excellent surface gloss and resistance to stress crazing.

*ASTM average Izod test values using notched ⅛ in. bar at 74 deg. F.

Refrigerator freezer door frame injection molded from TMD-5151 shows this material's adaptability to fabrication into intricate designs.



Toy train parts molded from TMD-5151, selected over other materials due to its good cold weldability, dimensional stability, and strength in thin sections.

Both compounds can be supplied in an unlimited range of opaque colors. Exhaustive tests assure blend-to-blend consistency so that color matches can be expected on orders received months apart.

Both types are highly desirable for refrigerator parts such as breaker strips, inner door liners, crisper trays, drip trays and butter compartments . . . for signs and display panels . . . for toys, housewares, novelties, TV masks, dust covers, housings, and numerous industrial applications.

New modern production facilities assure continuity of supply on a commercial scale. Write Dept. ZF-43.

BAKELITE

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IMPACT STYRENE PLASTICS

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BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street New York 17, N. Y.

In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

News of the Industry . . .

Jamison Plastics Corp. has moved into a new plant covering 31,500 square feet, which was laid out specifically for high production injection molding, as well as paint spraying, decorating and assembly of finished products. Their new adress is 1255 Newbridge Road, North Bellmore, Long Island, N. Y.

Tru-Cast Appoints Otto

Clifford E. Otto has been named metropolitan New York district manager for 'Tru-Cast' beryllium copper mold components, manufactured by Manco Products, Inc. His New York offices are at 520 Fifth Avenue.

The appointment was announced at Manco headquarters in Melvindale, Mich., by M. A. Nichols, company president.

Plastic Welding—Automatic!

Plant Plastics, Inc., 417 S.W. Church Ave., Knoxville, Tenn., announce automatic plastic welding equipment capable of welding 300 feet per hour. Equipment will be available on a rental basis.

Adhesives Manual Published

A new, profusely illustrated, twelve page manual on "Adhesives for Film, Foil, Fabric and Other Web Laminations" has been issued by Rubber & Asbestos Corporation, Bloomfield, New Jersey.

In addition to over forty-five actual photographs of typical laminations, this new booklet features two new charts, reported to be the first of their kind in the adhesives industry.

Copies of the deluxe, three color, twelve page Manual #110, may be obtained without charge by writing—Rubber & Asbestos Corp., Dept. "P", 225 Belleville Ave., Bloomfield, New Jersey.

Hanszen Builds Plant

E. W. Hanszen

E. W. Hanszen, Dallas, a member of the Society of Plastic Engineers, has begun construction of a new plant for the manufacture of plastics and fiberglass laminates.

The first unit, to be opened November 1, will contain 3800 square feet of factory, office and display space. Production of plastic products is scheduled for mid-November.

The new Southwestern firm will do custom molding, manufacture glass-fiber laminates and handle special requirements.

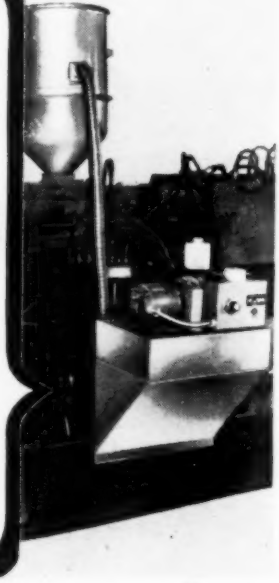
Products will be marketed under the "H-I" trade mark.

Custom molding operations will include flexible vinyl resins made into door gaskets, corrugated closure strips and sporting goods. The firm will produce sporting equipment and aircraft parts of the glass-fiber line.

Hanszen formerly was area supervisor of the Texas City plant of the Carbon and Carbide Chemicals Company. He has 12 years experience in the plastics industry and holds a Master's degree from Massachusetts Institute of Technology.

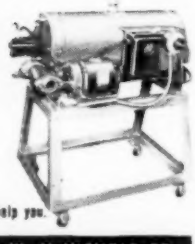
Upgrade Plastics Production . . . Downgrade Costs . . .

D&W HOPPER-DRYER



Efficient pre-heating and de-humidifying of material is just one of many jobs done by this timesaving accessory. It speeds production by eliminating handling—because material goes directly to the machine from receiving. No need to load and unload drying ovens. You save floor space, too, because the Hopper-Dryer can be installed easily on standard makes of injection or extrusion machines. Initial cost is less than a drying oven's. Operating cost is low, results are sure.

New Hopper Loader — For continuous automatic feed of any injection or extrusion machine. Clock timer control for starting and stopping. Dust-free operation.
"Die-Temp" Control — Positive-acting, self-contained mold temperature control at any level between 100-400 degrees F. Fast, compactly built to save space.



Write today for complete information on how all three of these machines can help you.

THORESON-McCOSH, Inc. 18208 W. McNICHOLS RD. DETROIT 19, MICHIGAN PHONE: KENWOOD 1-8877

Old Time Craftsmanship

in a matter of minutes

EVERYONE admires the work of the old-time craftsman. From his littered shop came wares that smacked of great skill and tireless finishing. But, because he had to spend long hours on each piece, production was low and prices high.

It's different today. Plastic molders work hard designing their products, just like the old-time craftsman. But, once that's done, they make their labors pay off. Refrigerator inner doors, radio cabinets, housewares, toys, wall tile, and hundreds of other colorful, beautifully designed products come off the production line in great quantity and at attractive prices. Modern chemistry —and the wonderful new plastics that it has created — is the secret of the plastic molder's advantage over his counterpart of yesteryear. These new plastics can be molded into perfect reproductions of the original — all in minutes instead of hours.

To supply the plastics industry with the best quality molding materials, Koppers Chemists have developed a whole family of polystyrene plastics. Some are especially tough, others stand higher temperatures or are easier to mold. All products made with Koppers Polystyrene come in attractive colors, have a smooth finish, and are light in weight. Each Koppers Polystyrene is designed to make products better, and to help cut production costs, so that plastic molders can combine the craftsman's skill with mass production techniques, to bring more attractively priced, high-quality products into your home.

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Chemical Division, Dept. SPE-114, Pittsburgh 19, Pennsylvania

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by General Electric Company

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Quotations promptly given

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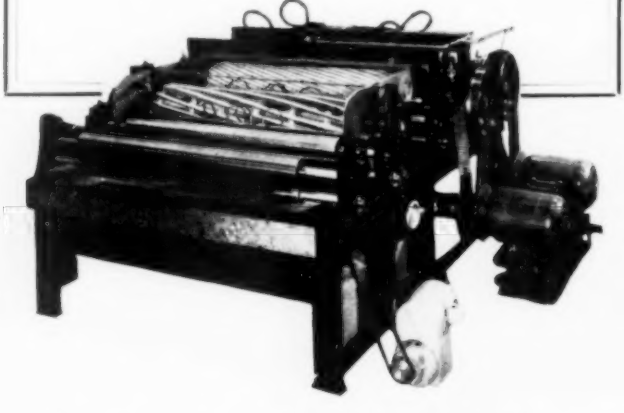
Here are Important Economies



Our Panel Brushing Machine Can:

1 Eliminate Brush Finish Press Pans
2 Make your wood patterns more natural
3 Salvage panels with slight surface imperfections
4 Eliminate stock room damage by creating the Luster Finish immediately before shipping

FOR INFORMATION WRITE TO . . .

THE FULLER BRUSH COMPANY
MACHINE DIVISION, HARTFORD 15, CONN.

Industry Notes . . .

Mylar Booklet Ready

Two new technical reports concerning "Mylar" polyester film — one covering the film's physical, chemical and electrical properties, and one on adhesives developed for bonding "Mylar" to other materials — have been issued by the Du Pont Film Department.

Copies of technical reports TR-1 (properties), and TR-2 (adhesives), may be obtained from the Du Pont Film Department, Wilmington 98, Delaware.

Toxicology of Acrylonitrile

"The Toxicology of Acrylonitrile," published by American Cyanamid Company's Petrochemicals Department is now available. It contains abstracts of the more important data, both from published literature and the Company's files. The 16-page booklet also contains a section on the treatment of persons who have been exposed.

The booklet is available on request from American Cyanamid Company, Petrochemicals Department, 30 Rockefeller Plaza, N. Y. 20, N. Y.

Gering Brochure On Tubing

Responding to a recently accelerated demand for plastic tubing of especially small gauge, Gering Products, Inc. of Kenilworth, N. J., thermoplastic converters and extruders, has found an eager and expanding market for their production of Ger-Flex vinyl and Ger-Tube polyethylene tubing.

Gering has just prepared informative literature on both "Ger-Flex" and "Ger-Tube" tubing, available on inquiry.

GENUINE IMS SILICONE SPRAY
SHIPPED AT ONCE -- ONLY FROM
INJECTION MOLDERS SUPPLY
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experienced molders already know
"You get just what you pay for!"
that's why they specify —
IMS SILICONE SPRAY
Balanced-Proven Formulation and Faster to Apply from Exclusive All Metal Nozzle

It's Delivered FREE—It Costs Only
$2.00 ea. (Sample) $1.50 ea. (Dozen) $1.37 ea. (Gross)

Beware of Imitations!

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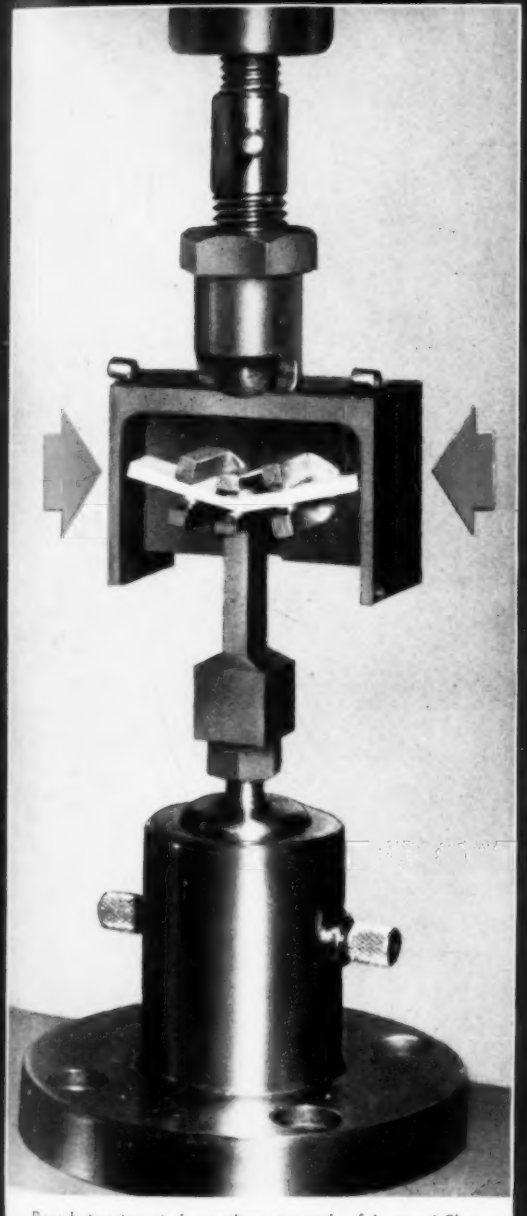
Flexural fatigue tests prove it!



Rough treatment dramatizes strength of Lustrex! The Flex fatigue tester, one of many precision instruments used in Monsanto's laboratories, bends a sample of Lustrex Hi-Test 88 styrene plastic back and forth to test flexing strength.

Result: Lustrex Hi-Test 88 styrene plastic offers almost *15 times more resistance* to flexural fatigue than general purpose styrene!

Actual laboratory tests, shown in the photo, have dramatically proved that Monsanto's Hi-Test 88 styrene plastic offers almost *15 times more* resistance to flexural fatigue than general purpose styrene! In addition, your product will benefit from Lustrex Hi-Test 88 styrene plastic's other tested advantages:

Compared to general purpose styrenes:

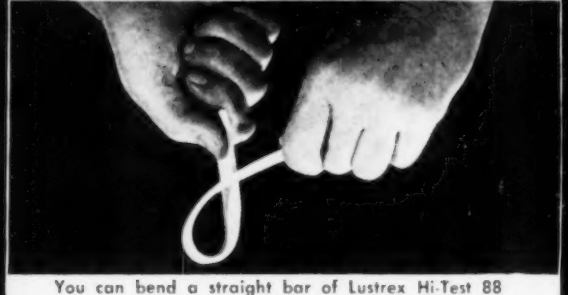
- 5 times tougher than general purpose styrene!
- Up to 500% higher impact resistance!
- Superior resistance to strain!
- High surface gloss with excellent color stability!

Compared to other high impact styrenes:

- Greater resistance to flexural fatigue!
- Improved flow characteristics!
- Greater total elongation values!
- Perfect for lacquering jobs!

For full information on how Lustrex Hi-Test 88 styrene plastic can help you improve the quality and sales appeal of your product, write to MONSANTO CHEMICAL COMPANY, Plastics Division, Room 2909, Springfield 2, Mass.

MAKE YOUR OWN FLEXIBILITY TEST!



You can bend a straight bar of Lustrex Hi-Test 88 styrene plastic like this into a pretzel shape — a dramatic demonstration of its greater flexibility and toughness!

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From the mold shown, Bridgeport Moulded Products Co., Inc. produced the handsome grille of the Philco air conditioner pictured in the inset—one of the hundreds of fine products for which molds have been created by the skilled hands and modern facilities at Newark Die Company.

Big molds have been a big factor in the growth of the plastics industry. For more than 30 years Newark Die has led in the design and construction of all types of molds.

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YOUR NATIONAL OFFICE

Appointments

Dr. Norman Skow, member of the Philadelphia Section of the Society and Director of Research of Synthane Corporation has been appointed by the National Board of Directors to be the Society's representative on the American Delegation on plastics to the International Standards Organization (ISO).

Funds have been made available by the Society to Dr. Skow to attend the 1954 meeting in London, England. The setting up of standards on plastics to be used in international trade is a most important project and one, considered by the Directors, in which the Society should take an active and continuing interest.

The Society is anxious to cooperate not only with the ISO but with all organizations whose aim is the promotion of the arts, sciences, standards, or engineering practices connected with the use of plastics and to have our members represent the Society in such groups. **But it is essential that when a member is desirous of representing the National Organization, he obtain the authority to do so from the National Board of Directors.**

Another important appointment was that of Professional Member, Don Hoffman, National Vice President of the Society and Plant Manager of Evans-Winter-Hebb as Administrator of the Society's Professional Activities for a term of three years. The local sections will be requested to continue individual project work but in addition plans are being developed to begin work on a national-scale project that will be announced in detail at the Annual Business Meeting of the Society at the Conference in Atlantic City in January.

Atlantic City

On the subject of the forthcoming SPE National Technical Conference—our eleventh consecutive annual conference—the tremendous effort the 1955 Conference Committee has already expended in making this event the most important and successful to date should be acknowledged by all. On October 15th news of the announcement of the Conference was spread throughout this country, Canada, and abroad. During November each member of the Society will receive an individual invitation to attend the Conference. To obtain the best accommodations register well in advance!

Meetings

On October 27th and 28th a conference on "Plastics in Building" conducted by the Building Research Institute was held at the National Academy of Sciences in Washington, D. C. It is of interest to note that although not in the capacity as official representatives of the Society, SPE members, Mr. Ed Cooper, Mr. Albert G. H. Dietz, Dr. Gordon Kline, Mr. Hiram McCann and Dr. Raymond Seymour were program speakers.

The brochure published about the conference states that "these conferences are entirely technical and objective in their nature and have for their purpose the stimulation of progress in the development of building materials and products."

Copies of the proceedings are being printed. Information can be obtained by writing to Building Research Institute, 2101 Constitution Ave., Washington, 25, D. C.

The National Education Committee of the Society met at Princeton October 14. One item considered by the Committee among many others was an official definition of the term "plastics engineer." While basic, this is the first step in realizing our objective of obtaining full recognition of plastics engineers as an independent branch of professional engineering. But more about this in the December JOURNAL.

Sincerely,

P. L. Underwood

Executive Secretary

Set Sail for Atlantic City

Some Members of the Conference Committee

Bishop

RICHARD B. BISHOP, Honorary Chairman, is an indefatigable worker for SPE. He is currently in the midst of his second term as a National Director. He was chiefly responsible for founding the Philadelphia Section in 1936, and was working chairman of the 1947 conference. He holds a B.S. and M.S. in Chemistry from Holy Cross and has done graduate work at Johns Hopkins and Rutgers University. After working for Socony-Vacuum Oil Co. for 14 years as Senior Research Chemist, he is now Director of Research with Foster Grant Co. in Leominster, Mass., where he lives. He is also active in the American Chemical Society.

Kissileff

ADOLPH J. KISSILEFF Chairman, in spite of his appearance says he is 50, male, married, and white. To which we must add that he enjoys a (fair) reputation as a **raconteur.** He is founder and First President of his company, Amplex Mfg Co. (There are **no** Second Vice-Presidents.) During World War II he was Director of Personnel, Fuze Division, Bulova Watch Co. and was educated at Wharton School of University of Pennsylvania.

Koch

GEORGE H. KOCH, JR., Co-chairman, is a former President of the Philadelphia Section. After several years molding experience he worked as a designer with Newark Die Co. until starting his own Company, Oak Engineering for design of molds and molded parts. He received a B.S. from St. Joseph's College and studied at Newark College of Engineering. He edits the Philadelphia Plastics Press and shoots golf in the seventies.

Bracken

WILLIAM O. BRACKEN, President of SPE in 19[illegible], has continued to devote a great deal of his time and energy to Society affairs, currently serving as chairman of the Technical Advisory Committee, as well as Program Chairman for the Conference. He holds a B.S. in Ch. E. from Tufts College, and develops new uses for cellulose derivatives for Hercules Powder Co. He lives with his wife in Newark, Del. and lists photography, golf and gardening as his hobbies.

Darlington

HENRY S. DARLINGTON, JR., Philadelphia Section President, is serving as Treasurer of the Conference Committee. He studied at the Drexel Institute of Technology. He works hard at his post as Engineer with A. H. Wirz Co. of Chester, Pa. to support an old-fashioned size family. A lot of his spare time is spent fishing.

Fitzpatrick

EDWARD J. FITZPATRICK, Secretary of the Conference Committee, has been in plastics since 1936. First at the Sprague Electric Co. in North Adams, Mass., then for four years with the International Resistance Co. in Philadelphia, before taking his present position with F. J. Stokes Machine Co. as Plastics Specialist. Hobbies are amateur radio and football.

Set Sail for Atlantic City

Eleventh SPE Technical Conference Plans

Atlantic City, New Jersey, January 19 Through 21, 1955

The technical, sales, and production staffs of custom and proprietary molders cannot afford to pass up the opportunities offered at the forthcoming Technical Conference in Atlantic City this January. Not only will there be the most complete and fully-rounded program ever presented at a Plastics Technical Conference, but in addition, round-table discussions with seasoned, well-experienced panels to lead them, at which every type of molder's problem will be thoroughly analyzed.

Representatives of material suppliers will bring the story of latest developments in new materials as well as improvements in making and using many of the established plastics. Also, in this field will be a symposium, treating with the evaluation of all plastic materials. The various plastic families have become so inter-married that the features of the cousins and neighbors are unrecognizable to many of those familiar with the brothers and sisters.

Papers will also be presented dealing with new fillers and reinforcement materials, of special interest to the low-pressure molders.

Practical methods for fabricating and molding fluorocarbon plastics, considered technically difficult by molders unfamiliar with them, will be handed out by a panel of combined forces representing material manufacturers and prominent convertors. Hot-runner molding will be discussed as it relates here, and also in all its phases in a separate forum.

In line with this double-viewpoint approach will be a polyethylene molding panel which will disseminate information helpful to molders of this material, showing them how to take advantage of the properties of this unique material in facilitating molding and applying it to new uses.

Machinery and equipment manufacturers have been assigned sufficient time to present the highlights and results of their recent endeavors. Special features in this category are a discussion of automatic molding equipment, (the answer to inroads by vacuum-forming?) and another particularly well-manned panel on control equipment. The latter will cover new techniques for injection molders never before presented to an assemblage such as this, a precision method of time and weight control.

A lot of molder's headaches stem from the molds he must use to make products of quality. Here a triple-threat attack will be launched by assembling the first really complete panel discussion of all aspects of mold design. At another time, so that there will be no conflict, a representative group of metallurgists from various steel mills will take up the pros and cons of hard versus semi-hard injection mold steels, pack-hardening versus through-hardening compression mold steels, and the advent of precipitation-hardening steel alloys to the plastic mold field. They will be guided on their course by both a prominent mold-maker and an experienced mold engineer supplied by a leading custom molder of all plastic materials. Such a discussion has never been attempted before, and cannot fail to be of tremendous help to the mold steel suppliers as well as to the tooling engineers and designers.

Molders will always listen attentively to any proposition which will enable them to extend the scope of their operation and furnish moldings to industries and for applications where they are now at a disadvantage. In this category is the perfection of the process of making molds of hard nickel by electroforming, enabling the execution of details and textures never possible previously. Since cost-reduction of molds is an important factor in obtaining business, they will be delighted to hear in what areas this is also indicated by this technique.

Marking, finishing, and painting methods and cost-saving ideas will be given complete treatment by an engineer connected with the leading processor in this field. Methods of testing and inspection, originating in the research laboratories of material manufacturers will be relayed to the molders, for their protection and practical use, by the men responsible for developing them in their respective companies.

This completes the part of the agenda of interest to molders as far as the actual manufacture of their products is concerned, but one of the most important subjects, a factor in the successful execution of their services, must be given proper emphasis: the best application of the right plastic with the proper design for the particular part to be molded. This is perhaps the most difficult of engineering functions in plastics, since it requires a good working knowledge in so many fields. Here the molder will be aided by experts in the application of plastics in several major industries. Representatives of every major purchaser of molded parts are invited to attend and will contribute essential information merely by giving their opinions. In the cost analysis they are the best judges of a material's (or a molder's) qualification—the customers!

Plan now to spend a most enjoyable and worthwhile week at Atlantic City during the post-Christmas let-up. Prepare yourself and your associates for the tough year ahead. Two-and-a-half days of helpful, informative association with your suppliers, competitors, and customers, while "picking the brains" of the entire industry!

New WATSON-STILLMAN 5 oz.

Automatic INJECTION MOLDING MACHINE

Here is the answer to Industry's demand for a high speed automatic plastics molding machine with the latest features for more production at lower operating costs.

- **FULL HYDRAULIC CLAMP**
  Assures positive clamping pressures. Slowdowns are adjustable to suit different molds, increasing mold life.
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  Over 400 cycles per hour.
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  Three zone heat controls enables better plasticizing at lower temperatures.
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  Utilizes maximum shot capacity—gives you greater material coverage.
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  Press will close under low pressure. Automatically protects die by stopping machine if obstruction prevents full die closing.
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Plastic Material Problems in Power Distribution

Barney Kellam
The Hydro Electric Power Commission of Ontario, Toronto, Canada

INTRODUCTION

The Hydro-Electric Power Commission of Ontario is a publicly-owned electrical utility. It serves municipalities as a wholesaler, rural areas directly as well as certain large industrial customers. To give an idea of its size a few figures are in order. The province stretches for 1000 miles in either direction. The high-voltage transmission lines total 14,800 circuit miles; the number of our ultimate customers is 1,317,000. Our dependable peak capacity is three-and-a-third million kilowatts. The gross investment in fixed assets is $1,177,000,000. "Hydro", as it is known familiarly, is among the largest electrical utilities on this continent.

The research and testing needs of the Commission are taken care of by four departments comprising the Research Division. The study of plastics is one of the functions of the Chemical Research Department. Here we evaluate products of plastics and synthetic rubbers such as wire insulation and sheaths, adhesive insulating tapes, special protective coatings, pipe, adhesives, tableware, of which we have used a quarter-of-a-million pieces, and others. We provide data to enable decisions to be made whether plastics shall be used for any particular application, and what type. We can summarize our work by saying that we try to prevent the misapplication of plastics.

Out of our experiences have been chosen three subjects to illustrate the problems we have and our attempts to solve them.

POLYVINYL CHLORIDE

THE COMMISSION HAS USED polyvinyl chloride for the insulation and sheathing of single and multi-conductor control cable since 1945. We use only the type known as TW, suitable for underground and wet locations. Both the Underwriters' Laboratories and our Canadian Standards Association limit pvc to a maximum of 600 volts. In this range it has an advantage over other types of moisture resistant materials in being appreciably less expensive. Since 1945 we have installed more than 1000 miles of pvc multi-conductor control cable making us among the world's largest users of this type. Control cable is used on fixed loads in contrast to power cable with varying loads. Although covering a wide variety of service conditions there has not been a single failure in our pvc control cables.

Despite its many advantages there was an application for which we considered pvc unsuitable. In our hydraulic stations control cables are used under the face of the dam in a near-vertical position from the turbine floor to the control room or switching deck. This height varies from 20 feet at our Rat Rapids station to more than 250 feet at the Sir Adam Beck-Niagara Generating station No. 2 under construction.

For such an application the problem with pvc arises out of a characteristic known as "cold flow", a movement of the material under concentrated loads. In this case the concentrated load is that exerted by the customary cable "grippers" which are necessary to hold the cables in their near-vertical position. The effect of such grippers is to cut deeply into the sheath or insulation as is shown in figure 1. Because of the other advantages in the use of pvc, we gave thought to the development of a fastening device that would permit pvc to be used for near-vertical or vertical applications.

REQUIREMENTS OF A PLASTIC-CABLE FASTENER

The requirements for a plastic-cable fastener are as follows: the pressure of the gripper or fastener must be distributed over as large an area as possible; one size should be adaptable to a wide range of cable diameters; it should require a minimum of skill to apply; it should

Barney Kellam

Figure 1. Marks showing cold-flow of PVC insulation under force exerted by cable "grippers".

Figure 2. Metal strip fastened by vinyl tape to replace "gripper".

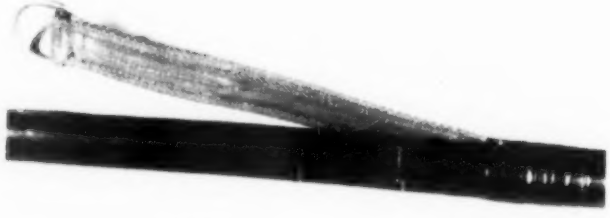

Figure 3. Completed fastener which gives satisfactory service.

Figure 4. New type fastener being tested under cable load.

be highly ozone-resistant as ozone is always present in our generating stations; there should be some degree of adjustment between fastener and support; it should not be costly; it should have a long useful life.

Incidentally, the matter of service life is ever-present in our work. To our engineering associates service life means at least 30 years. They get that and more from electrical components, why not from plastics?

STEPS IN THE DEVELOPMENT OF A FASTENER

With these requirements in mind, the initial form of the fastener was a long brass strip curved to conform to the cable and covering one-third of its circumference. The metal strip was taped to the cable by means of an adhesive vinyl tape 10 mils thick. This fastener had ample strength, requiring a minimum of 200 pounds to cause the cable to move with respect to the brass strip. The next major step was the use of a belt made of a flexible material having a greater conformability to different cable diameters. The final form of the belt was a polychloroprene-impregnated two-ply cotton belting, for ozone resistance. Another step was the extension of the belting beyond the taped portion, the end of the belt being formed into a loop containing a brass Dee ring to which the end was stitched. See figure 3. Thus, after a number of steps each of which was given load tests, a fastener was finally obtained that appeared to fit the requirements.

TESTING THE FASTENER

A series of laboratory tests was undertaken to determine the behavior of the fastener under various loads. A one-inch diameter multi-conductor control cable was used containing nine pvc-insulated conductors of No. 16 gauge enclosed in a pvc sheath. The new fastener was attached to a number of short lengths that were suspended by the Dee ring from a horizontal support. Various weights were attached to the bottom of the cables. A number of horizontal white lines and one long vertical line was drawn on the tape and cable. These served to indicate any movement of one part with respect to another, and the movement could be measured. After several months on what we considered to be a normal load, i.e. 40 pounds, no changes were detected. On 80 pounds there was a vertical adjusting movement of the tape at the top amount to 1/32 inch, after which there was no further change.

When these laboratory tests were reported the fastener then came under consideration for use at the Sir Adam Beck-Niagara G.S. No. 2. Here it was planned to have several hundred multi-conductor control cables insulated and sheathed with pvc, hang vertically for some 250 feet. Would this new fastener be suitable? It now became highly desirable to subject the fastener to conditions closely simulating those that would obtain at Niagara Falls. We obtained permission to use one of the stairwells of our 17-story Head Office and here we planned to hang two cables for test.

When it came to installing the cables two methods were considered. Should we unreel the cables on the ground, attach the fasteners at the required intervals and haul the assembly up by the Dee rings, or take the reel up to the 17th floor, play out the cable into the stairwell and let it hang while the fasteners were taped on? We chose the latter method. As the 218-foot length hung in space, the upper end snubbed around the reel, it began a rotating movement that appeared to stop after about an hour. The fasteners were then taped on. Had we followed the first method, the unwinding of the cable would have thrown the fasteners out of vertical alignment. Both cables are of the nine-conductor No. 10 gauge

diameter over the pvc sheath and weighing [illegible] Cable No. 1 is 218 feet long, hanging vertically from the 17th floor to the sub-basement, its 175 pounds being supported by four fasteners. Cable No. 2 is 121 feet long, its 100 pounds being held at the top by one fastener, representing about 2½ times normal loading. Figure 4 shows one of the fasteners of cable No. 1 and the method of attaching to the supporting baluster, using a snaphook and chain.

For the first two weeks we frequently examined the white index lines drawn on the parts of the fastener for changes in position. During this time the top turns of the tape stretched with the belt between 1/32 and 1/16 inch, the movement being upward. Equilibrium was established after this and the movement stopped. During the initial adjusting period the tape on all fasteners also exhibited a rotating or unwinding movement. Tests carried out earlier in the laboratory showed clearly that the greater the tension when applying the tape and the higher the ambient temperature the greater is this unwinding movement or creep. The temperature at the fasteners varied from 86°F at the 17th floor to 80°F at the third floor. However, despite a heat wave in early September ending with 100°F the fasteners are holding the cables in unchanged position after 12 months of suspension.

The test shown in figure 5 above is one we developed in our laboratory to determine the creepage of competitive tapes and means for reducing it. It was found that if the initial and final few turns of tape are put on without any tension, the movement was reduced to a minimum. The movement of tapes on glass did not compare with that wound on the pvc sheath. This was due to the migration of plasticiser from the sheath into the adhesive on the tape. One would have supposed that the adhesive would be in equilibrium with the plasticiser in the vinyl tape backing and not be affected by that in the sheath. However, the stretching of the tape in application and the higher operating temperature both tend to upset this equilibrium. The adhesive takes on more plasticiser which results in a more slippery adhesive and therefore more creep of the tape, particularly under stress. Eventually, however, equilibrium is again attained and the movement stops, probably aided in part by the relief of stress.

As a result of this work, a set of instructions have been drawn up with specifications for the one-inch-wide tape that is suitable for cables from 5/8 inch to 1-1/8 inches in diameter, and for the vinyl adhesive tape and the method of applying it. One installation of some 36 cables 40 feet long was made at our Crystal Falls generating station in September 1952 and is satisfactory. It appears likely that the new fastener will be used at the St. Adam Beck-Niagara No. 2 generating station.

EXPERIENCES WITH POLYETHYLENE AS AN INSULANT

In 1948 the Commission established the A.W. Manby Service Center in a western suburb of Toronto. The area is about 300 acres and contains numerous buildings, shops, the largest garage under one roof in Canada, and a large storage depot. It was planed originally to install a network of paper-insulated lead-sheathed cables (PILC) for power distribution. However, at that time PILC was available only after months of delay. In addition, it was known that the Center was due for a large building program and no one could even guess at the probable load requirements. It was decided, therefore, to use the readily available and inexpensive polyethylene-insulated cable until the load requirements could be established, which would take about three years.

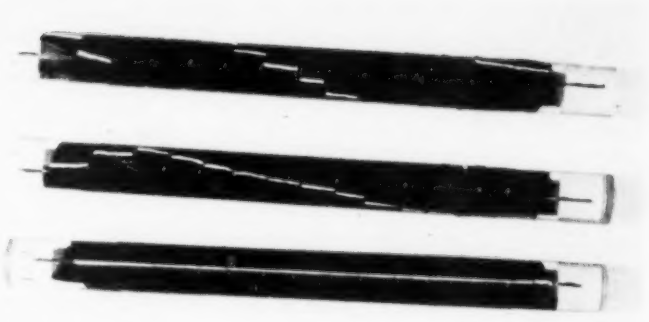

Figure 5. Test pieces showing creepage of binding tape.

Figure 6. Molded polyethylene insulation joint.

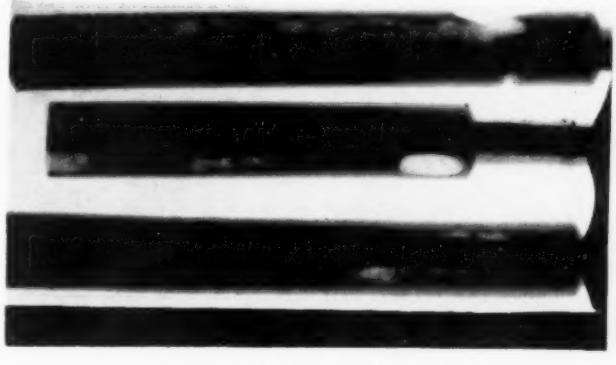

Figure 7. X-Rays of molded joints.

The network consists of single-conductor cables of sizes No. 2, No. 4 and No. 6, at 4 Kv, 2300 volts from line to neutral. All lines are underground in both fiber and cement-asbestos ducts. Runs vary in length between manholes from 250 to 450 feet. There were periods of about a week during the first three years when the manholes were filled with water. This has been somewhat reduced by the use of sump pumps.

All joints are at manholes and were originally made by the installation contractor. A cylindrical mold was used and filled with pieces of the insulation probably taken from scrap lengths. The outside of the mold was heated with a torch. The excess polyethylene flowed into a riser and also permitted escape of air. When cold, the mold was removed and the sprue trimmed off. See figure 6.

The first failures in this system were at the joints. They were eventually all replaced using a different technique. Three of the original molded joints were X-rayed and are shown in figure 7. The central black portion in each is the spliced conductor with splicing sleeve in the center. The gray portion around the conductor is polyethylene and the voids are apparent in the much lighter

Figure 8. Polyethylene tape joint fused with a blowtorch, cut apart for examination.

Figure 9. Test specimens after accelerated environmental cracking.

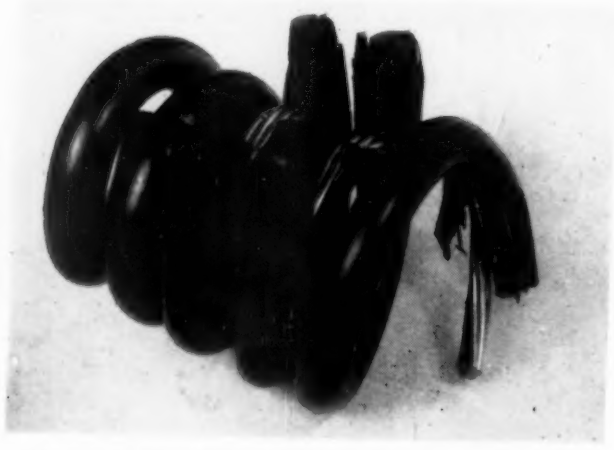

Figure 10. Cracking test specimen shows uneven failures.

areas. Note the eccentricity of conductor in the upper joint. The small scattered black spots were a puzzle at first until two were picked out and analyzed. They were of copper and we think they were sliced out of the conductor when removing the insulation to fill the molds.

The new joints were made up using a technique developed by the electrical maintenance staff at the Center. The space between the tapered-down insulation was filled with a clear 5-mil polyethylene tape ½ inch wide. The taping extended about two inches onto the wire insulation on both sides and built up to about ⅛ inch thick. Several layers of plain glass fiber tape were then put on half-lapped and the ends tied down.

Using a blow-torch, heat was applied with the object of fusing the polyethylene tape into a solid, homogeneous mass and fusing it to the insulation on the wire. This requires considerable skill as insufficient heat will not fuse the layers and too much heat causes the softened mass to move and eccentricity of the conductor. Figure 8 shows two such joints cut for study. The outer portion of the tape in the top joint is fused but the inner portion is not. The tape in the lower joint is fused throughout. It is of interest to point out here that a joint in each conductor of a three-phase system insulated with polyethylene can be made in a morning. To do this with PILC takes all day.

Three years after installation a failure occurred about 100 feet in from a manhole, obviously not a joint failure. One of the single-phase lines fused itself to the neutral. A study of all the circumstances and of the highly-alkaline fluid in the duct pointed strongly to environmental cracking being the cause, or a major factor. Since then there have been more failures of a similar nature, the time between installation and failure being about the same, three years.

We can dispense with a discussion of environmental cracking since the original and thorough work of the Bell Telephone Laboratories* on that subject has been well publicized. It is sufficient here to say that when polyethylene is subjected to biaxial stress such as a combination of a twist and a bend, and while so stressed it comes in contact with certain fluids (the "environment"), it will crack. The time taken to crack depends on the severity of the stress, the nature and temperature of the environment and the molecular weight of the polyethylene. Alkalies, soaps and detergents are some of the environments causing cracking.

We wanted a simple test for cracking that could be made directly on the cable, so we twisted and bent a length and immersed it in a solution of a detergent that the Bell Labs had found would enormously accelerate this effect. This material is known in the U.S. as Igepal CA and in Canada as Antarox A430. All our 1947-8 material cracked on this test in 2 to $2\frac{1}{2}$ hours. See figure 9. This period should be compared with three years in the field. More recent polyethylene, however, with higher average molecular weight, refused to crack under 96 hours. We therefore returned to the more severe Bell test, using a small hole drilled through the insulant as a "stress raiser" in place of a precisely-drawn slit. We are still searching for a simple field test but success is doubtful since the smallest variation in dimension or technique results in wide variations in time of cracking. In one instance we wound a helix on a mandrel, drilled a hole through each turn and immersed the helix in the environment. We got a different time for three turns and the other two would not fail. See figure 10.

We were asked for a recommendation what to use to replace the old polyethylene cables at the Center as they fail. It so happens that the alkaline conditions existing there that promote cracking of polyethylene are also highly corrosive to lead sheaths. Taking in all consider-

*V. T. Wallder, "Polyethylene for Wire and Cable

...specially the demand for long service life, we have ...ended a special pvc-sheathed black polyethylene ... index under 1.8. This should eliminate environ... cracking entirely, reduce considerably oxidation ...ding air and protect the insulant during drawing-... ...tions. Withal, we have an economical cable, light ...le and permitting quick splicing and jointing. ...ch installation has been made and another on ... We shall watch this, of course, with considerable ...

...ddition to testing for cracking, we had built ... an extrusion plastometer, or melt indexer, identical to that required for ASTM D-1238. Melt index is a number, which is the number of grams of polyethylene extruded under prescribed conditions of temperature and pressure through a standard orifice. There is a relation between average molecular weight and melt index. The higher the molecular weight the more viscous is the polyethylene and the less the amount extruded. Therefore, a lower melt index indicates a higher average molecular weight. It must be pointed out, however, that distribution of molecular weight also seriously affects the behavior of polyethylene. At present there is no method for determining this. Not only do we check the melt index of insulation but also that of polyethylene pipe which will be discussed later.

Recently we met with a peculiar phenomenon in running the melt index of a sample from a cable that had failed in service. The failure was believed due to operation well above the design voltage and under conditions promoting corona. The extrusion had a pattern on its surface instead of being glassy smooth, although its index was normal, 1.8. Whether this can be tied in with degradation of the insulant due to oxidation remains to be learned. That it was seriously degraded is indicated by the abnormal change in power factor from 0.001 to 0.017, at 10 megacycles. See figure 11.

PLASTIC PIPE

Early in 1951, during a shortage of suitable metal pipe, we were asked to look into the use of plastic pipe as a replacement for water supply purposes. This meant not only testing to determine suitability but also collecting data on methods of handling and installation in the field.

Since then the Commission has become increasingly interested in plastic pipe, and while our experience based on use has been limited, we have become more familiar with the factors involved in the evaluation of plastic pipe for certain applications. Again our associates speak of service life in terms of 30 to 40 years. Plastic pipe has been in use for as long as 10 years and as short as two; but even 10 years is a comparatively short period in the life of some metal pipe that plastic hopes to replace. Our tests, therefore, are thorough to show up any weaknesses or limitations.

WATER-SUPPLY PIPE

One of the three services we have in mind is for water supply purposes, the pipe being underground. We have several shortlength polythene installations that have given satisfaction. One large network was installed underground in Sudbury in the fall of 1951, whose total length was 1500 feet, while the longest straight run was 600 feet. This network served primarily for watering the grounds and supplying water for various purposes about the station. There were 9 risers installed, four of polyethylene using insert fittings and ring clamps, and 5 of rigid, high-impact styrene copolymers, using threaded couplings. Since the level of the ground did not permit draining the system before winter, compressed air was blown in to clear the water. In the following spring it was found that all the rigid styrene risers had broken at the threads of the fittings, the polyethylene pipe and risers however, were all OK.

The rigid plastic risers and fittings were replaced with galvanized iron material and this has gone through the winter of 1952-53 with complete satisfaction. The rather high thermal coefficient of expansion determined in the lab. gave us some concern when it was learned that a 600-foot run was planned, but it has not given any trouble in the field. The thirty banded or clamped connections have also given no trouble.

In our work on specifications for polyethylene pipe there has been discussion on whether high molecular-weight material should be specified to reduce the possibility of environmental cracking. Two examples of pipe that cracked near the clamp came to our attention recently, but we are not certain whether this was environmental cracking. The melt index was 7 in one case and 1.5 in another. Production pipe gave a melt index of 7, although molding granules of another producer gave indices of 0.96, 1.63, and 1.95. As production of polyethylene increases it is expected that the melt index will drop to 1.8 or lower. While this will improve the resistance to cracking it could still occur if the biaxial stress is great enough and environment is bad. Pipe can be made to crack simply by subjecting it to pressure with the outside coated with a suitable material*, and scratches 10 mils deep cut into the surface.

PLASTIC ELECTRICAL CONDUIT

Another service is that for electrical conduit, mainly for underground because of its corrosion resistance. Above ground its advantage is in its lightness, particular-

(please turn to page 45)

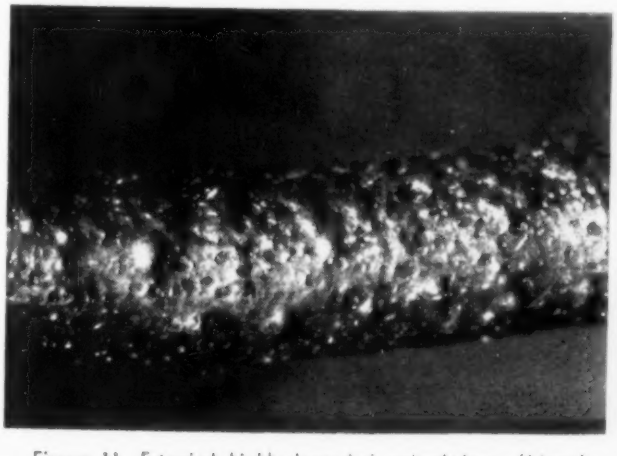

Figure 11. Extruded highly-degraded polyethylene. (Magnified 10X).

Figure 12. Test for compatibility between cable and conduit.

The concept of Control Charts

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This article on control charts is the third in a series on statistical quality control for the plastics molder, written by the Statistical Quality Control Committee of the Society of Plastics Engineers, under the chairmanship of L. M. Debing.

Introduction

In the previous articles of this series, a widely used statistical technique was discussed rather thoroughly. This technique, (the use of frequency distributions for quality analysis) was shown to be valuable for many reasons. The process history could be compared with specifications to show whether product quality was on the beam—how close our aim was in the general direction of the target, and how much scatter we had in our individual shots. The shape of the frequency distribution showed us the type of variation encountered, and gave us some clues as to the kind of corrective action required. Finally, the frequency distribution provides a means of presenting quality information to all personnel levels, to operators, set up men, tool room personnel, production and inspection supervision, tool design engineers—to all who are in any way concerned with product quality.

Although the histogram is valuable in analyzing past performance, it is not particularly suitable for evaluating up-to-the-minute performance. For example, the order in which the data are obtained is lost when the frequency distribution is plotted. We are not able to see from the distribution whether trends or cycles are occurring in our process. If tool movement or wear takes place during the time the pieces or samples used in the distribution are run, the resultant change in quality is not readily detectable by examining the distribution.

Another shortcoming of this method is the time that it takes to present the information. The actual quantity of production during the period necessary to obtain, plot and analyze the data may be such that a considerable amount of money could be lost in defective material before we ever knew about it. The frequency distribution may well be an excellent tool for obtaining information about processes, and is very effective in achieving long range quality improvements, but for the day to day quality decisions, something faster and more flexible is needed.

Bridging the Gap

How are we to make quality decisions more rapidly then by use of the frequency distribution? How are we to establish the existence of trends, cycles or excessive sample to sample variation in the data? One answer, and one which we shall pursue in detail involves the use of the previous quality history of the process as a "frame of reference," against which we judge the relative quality of each sample test value as obtained. Suppose that through the use of frequency histograms or by straight calculation we were to determine the average and standard deviation of our past quality performance, and by observing the pattern of variation we were assured that only chance or normal variation had been present. We could now construct a chart with the scale of measured values as the vertical axis. Then, drawing a horizontal line at the value corresponding to the average, and two parallel lines above and below the average at a distance of three standard deviations from it, we can obtain the "frame of reference" mentioned above.

Now the horizontal axis gives us something we did not have in our frequency histogram. The horizontal axis can be used as a time scale; we can divide it into units representing the time at which the sample was taken, or merely record the order in which the various data values were obtained. Figure 1 shows the relationship between this chart and the frequency distribution which shows the past history of the process.

As each sample is obtained we plot its test value on the chart so that it represents both the value obtained and the order in which the sample was taken. Figure 2 shows the following values plotted against the frame of reference.

Sample 1, 4.2; Sample 2, 5.7; Sample 3, 5.2; Sample 4, 4.5; Sample 5, 7.0; Sample 6, 3.7 etc.

You will notice the cryptic abbreviations LCL, AVE, UCL on the chart. These stand for Lower Control Limit, Average, and Upper Control Limit. Traditionally, the control limits are three standard deviations above and below the average line, which is all we need to know about them for the present.

The chart we have devised, with its upper and lower control limits, and individual measurements plotted in the order of production is known as a **Control Chart for Individuals.** As long as the data points plotted remain within the limits and are fairly uniformly dispersed on both sides of the average we can assume that the same

variation that we had when we calculated the ... continues to exist.

A More Reliable Approach

... control chart for individuals is useful for separating the "only to be expected" variation from that which indicates a change in the process. In fact, this is the purpose of statistical control charts. There is a catch, however. In order for control charts for individuals to work properly for us, we must be able to make a reasonably good assumption that the distribution pattern conforms to the Normal Frequency Distribution discussed in the preceding article. We are not always able to make this assumption, and are often in a quandary about how far a distribution may deviate from normal before the control chart system breaks down.

There is a way out of this dilemma. Back through the past several centuries, many mathematicians have contributed to a theory which has come to be known as the Central Limit Theory. Briefly, it may be stated as follows: "No matter what the distribution of individual values in a population, the distribution of the averages of several items taken at random from the population approaches the Normal Distribution as the sample size increases." Shewhart,[1] in 1924 demonstrated that for most processes, taking averages of three to seven values is sufficient to normalize the distribution.

Starting off then with the averages of small random samples being considered as normally distributed, we can as in Figures 1 and 2, construct a Control Chart of Averages, which is related to the distribution of averages as our individuals chart was related to the distribution of individual measurements. If the process is operating with only the expected variation present, a group of individual successive values can be considered as a random sample for the purpose of obtaining average readings.

We can immediately see a shortcoming in the suggested method. The average values show process variation on a group to group basis, but we have no way of estimating the spread of the variation within the group. A sample with an average of 20 could be made up of four individual readings of 19, 20, 20, and 21, or 15, 20, 27 and 18 or even a wider spread of values. We have no way of telling from the chart, what the situation actually is.

The original suggestion by Shewhart, was that another chart, showing the variation within the group by means of the standard deviation of the individuals in the group, could be used along with the averages. The two charts, taken together would then show the within and between group variation. Figure 3 shows how such a chart would be set up.

Shewhart reasoned further that the variation within small samples provided a good estimate of the chance or expected variation of the process, and developed tables by which control limits for both averages and standard deviations could be estimated from the average standard deviation of all samples.

In actual practice, this left something to be desired. The calculation of standard deviations is somewhat complex, and if the charts were to be used in the plant by inspectors and operators, something more simple had to be evolved. Fortunately for small samples (2 to 15 individuals) the **range** is very closely related to the standard deviation and is much more readily determined. The range is the difference between the largest and smallest individual value in the group. Shewhart proposed the use of Average and Range Control Charts as an effective means of controlling product quality, and this technique has been widely adopted, and is called the Shewhart Control Chart.

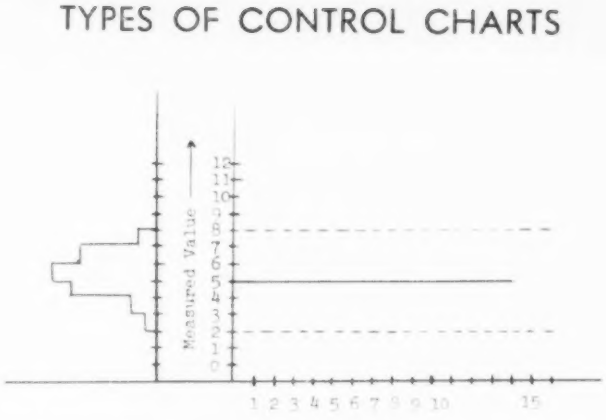


Figure 1. The start of a control chart, showing the relationship between the control chart framework and the frequency distribution.

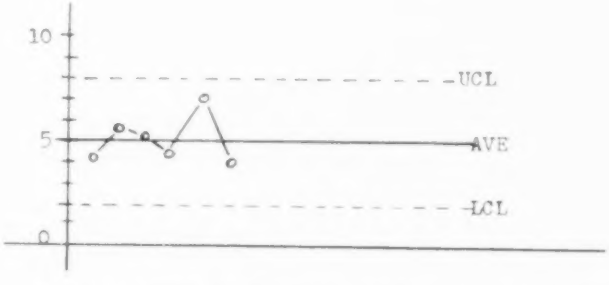


Figure 2. Control chart showing distribution of the group averages about total average. This chart does not show variation within any group.

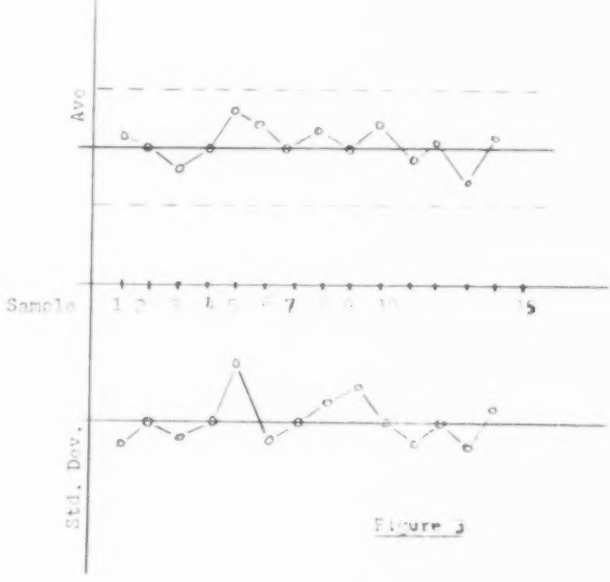


Figure 3. The top chart shows the variation of group averages, and the lower chart draws the standard deviation within each of the groups.

E. L. Grant[2] presents a very excellent discussion on Control Charts for averages and ranges, covering the theory, construction, calculation and interpretation. For the reader who intends to make actual application of these techniques, a thorough study of this reference is recommended. As a matter of general interest, the following advantages of Average and Range Charts over Control Charts for Individuals are presented:

1. The use of the normal distribution probabilities is more valid.
2. Trends or shifts in level are more readily detected.
3. Changes in variability can easily be seen on the range chart.
4. Control limits are easy to calculate.
5. Out of control points can be systematically eliminated prior to calculation of the control limits.
6. Averages are less sensitive to experimental error.
7. More data can be plotted in a given space, making recognition of long term variation clearer.

How To Do It—Calculation of Limits

The control limits for averages can be calculated by the same procedure outlined previously for calculating limits for individuals. For example, if each group average is considered as one data point, we can calculate the mean and standard deviation for these averages, and set up 3 sigma (3 standard deviation) limits around the mean. This technique is somewhat tedious, and might well have resulted in reluctance by industry to accept these methods of quality control. However, identical, and in some cases better, results can be obtained painlessly by following the technique outlined below.

In this discussion we will attempt to use the terms and symbols that conform to accepted quality control practice.

Subgroup—the individuals that are grouped together and averaged for plotting on the control chart for averages.

Subgroup size—indicated by the symbol n—the number of individuals in a subgroup.

Subgroup average—symbol $\bar{X}$, pronounced X bar.—the average of the individual values in the subgroup.

Average of the subgroup averages is denoted by the symbol $\bar{\bar{X}}$, pronounced X double bar.

The range indicated by the symbol R is the difference between the highest and lowest values in the subgroup.

The average range is the average of all the subgroup ranges, and is called $\bar{R}$ (R bar).

In Table 1, the factors for calculating the control limits for average and range charts are given. The following procedure shows how these factors are used.

1. Select the desired group size, and plot the averages and ranges.
2. Obtain the average of all the ranges ($\bar{R}$).
3. In the table find the value of D_4 corresponding to the group size selected.
4. Multiply $\bar{R}$ by D_4. This gives the upper control limit for the ranges.
5. Multiply $\bar{R}$ by D_3. This gives the lower control limit for the ranges.
6. Calculate the average of the averages ($\bar{\bar{X}}$).
7. Find the value of A_2 corresponding to the sample group size.
8. Multiply this factor by the average range.
9. Add the product ($A_2\bar{R}$) thus obtained to the average of the averages ($\bar{\bar{X}}$). This is the upper control limit for the averages.
10. Subtract the product $A_2\bar{R}$ from $\bar{\bar{X}}$. This gives the lower control limit for the averages.

TABLE I

Factors for calculating control limits for average and range charts.

n	A_2	D_3	D_4
2	1.880	0	3.268
3	1.023	0	2.574
4	0.729	0	2.282
5	0.577	0	2.114
10	0.308	0.223	1.777
15	0.223	0.348	1.652

More complete tables may be found in many references, including (3) and (4) at the end of this article.

It might be well at this point to illustrate the procedure by an example. On Table II we have listed 100 successive outside diameters taken on extruded vinyl plastic cord. Table III shows the same data broken down into 25 successive groups of 4, with the calculations conducted according to the preceding steps.

Example Worked Out To Illustrate Process

TABLE II

Successive Readings—Outside Diameter In Inches Extruded Elastomeric Vinyl Plastic Cord

1	.080	26	.081	51	.085	76	.081
2	.086	27	.079	52	.085	77	.080
3	.082	28	.080	53	.086	78	.082
4	.087	29	.080	54	.081	79	.086
5	.084	30	.084	55	.085	80	.082
6	.085	31	.080	56	.080	81	.083
7	.081	32	.086	57	.086	82	.083
8	.081	33	.087	58	.086	83	.083
9	.083	34	.086	59	.084	84	.082
10	.082	35	.084	60	.084	85	.079
11	.086	36	.084	61	.081	86	.081
12	.083	37	.082	62	.081	87	.082
13	.083	38	.079	63	.083	88	.086
14	.080	39	.085	64	.084	89	.086
15	.086	40	.085	65	.082	90	.082
16	.083	41	.083	66	.083	91	.082
17	.083	42	.080	67	.082	92	.085
18	.081	43	.084	68	.085	93	.085
19	.081	44	.081	69	.083	94	.079
20	.084	45	.083	70	.085	95	.082
21	.081	46	.079	71	.084	96	.086
22	.081	47	.083	72	.084	97	.083
23	.086	48	.085	73	.081	98	.084
24	.085	49	.084	74	.083	99	.082
25	.086	50	.085	75	.085	100	.087

TABLE III

The data of Table II broken down into groups of four

Sample No.	$\bar{X}$	$\bar{R}$	Sample No.	$\bar{X}$	$\bar{R}$
1-4	.084	.007	53-56	.083	.006
5-8	.083	.004	57-60	.085	.002
9-12	.0835	.004	61-64	.082	.005
13-16	.083	.006	65-68	.083	.003
17-20	.082	.003	69-72	.084	.002
21-24	.083	.005	73-76	.0825	.004
25-28	.0815	.007	77-80	.0825	.006
29-32	.0825	.006	81-84	.0825	.001
33-36	.085	.003	85-88	.082	.007
37-40	.083	.006	89-92	.084	.004
41-44	.082	.004	93-96	.0825	.007
45-48	.0825	.006	97-100	.084	.005
49-52	.085	.001			
				2.077	0.772

Sum of the Averages = 2.077

$\bar{\bar{X}}$ = Average of the Averages = 0.083

ΣR = Sum of the Ranges = 0.112

$\bar{R}$ = Average Range = 0.0045

Control Limits for Averages

$\bar{X} \pm A_2 \bar{R} = 0.083 \pm (0.729)(0.0045)$

Upper Control Limit for Averages

$0.083 + 0.003 = 0.086$

Lower Control Limit for Averages

$0.083 - 0.003 = 0.080$

Upper Control Limit for Ranges

$D_4 \bar{R} = (2.282)(.0045) = 0.010$

Lower Control Limit for Ranges

$D_3 \bar{R} = (0)(.0045) = 0$

Note: Values for A_2, D_3 and D_4 are found in Table I.

What Does It Mean?

In an operation like the one just discussed, we expect a certain variation in the measured dimension, and do not become unduly alarmed if the variation remains within the expected limits. According to our calculation, 99.73% of the averages of four measurements should lie between 0.080 and 0.086 inches, provided the process operates essentially as it did when the data were being collected. The control chart plotted below (Fig. 4) shows the normal state of control for this process, as calculated from the data.

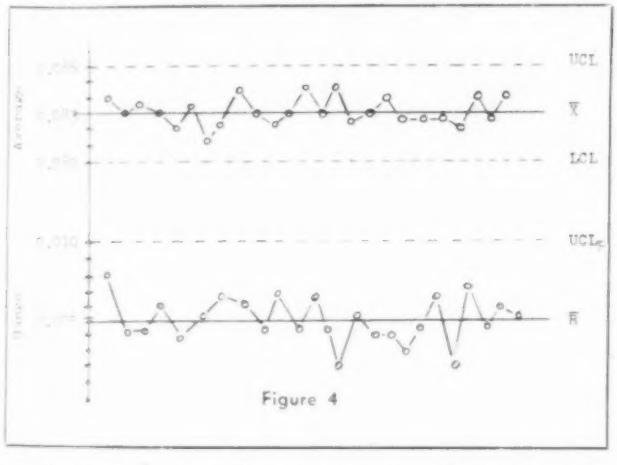


Figure 4

Suppose that on the same process, the pattern observed in the previous chart continued as below, (Fig. 5) with point A indicating the spot at which the new data plot starts.

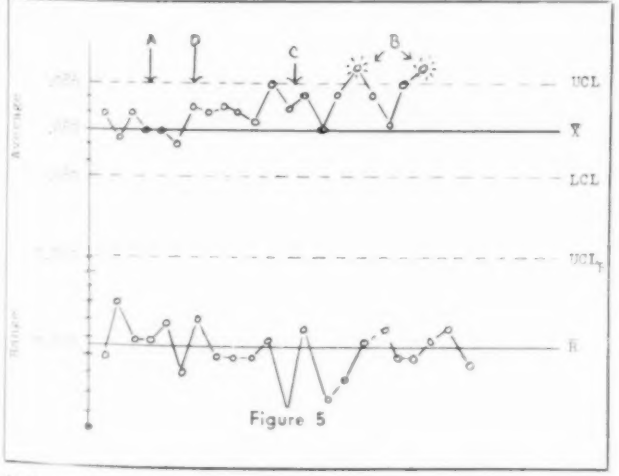
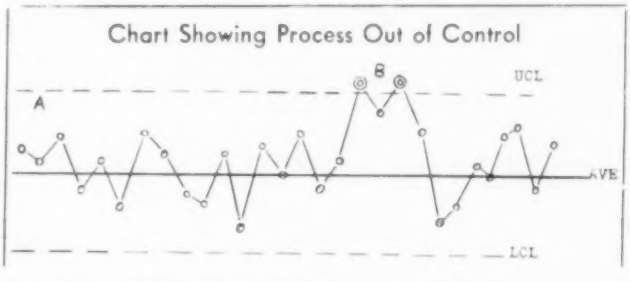


Figure 5

A survey of our control chart at this point shows us that at the two points marked as "B", the process actually went outside of the limits of expected variability. We can now make the statement, with 99.73% probability of being correct, that there has been a change in the process. These points are action points, and indicate the presence of an "assignable cause" of variation, that is, a cause of variation other than those which are normal in the operation. A further look at the chart tells us that at point C, we have had seven consecutive values on one side of the mean. At this point, we can make a sound conclusion that the process average has shifted, and that if nothing is done of a corrective nature, we can well expect that data will soon fall outside the control limits.

In checking back into process history to find the new cause of variation, our chart tells us to go back to some point prior to point C, rather than to look for the new source at data point B. In fact, we may well find at point D, vinyl resin from a new source of supply was introduced and the extrusion characteristics of this material differed sufficiently to give a higher diameter cord.

Interpretation of the foregoing data has made use of two control chart rules, the "rule of 7", and the existence of points outside the control limits. There are many other indications of non-random variation that can be recognized through the use of control charts. The following illustrations show some of the more common patterns and possible explanations. Reference (3).

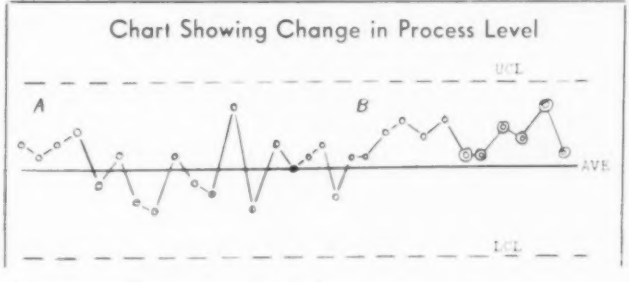


Symptom—Points above or below control limits.

This is the most obvious indication of an out-of-control process.

The chances of getting the two points circled at B from the process as it was run at A are about 1 in 500,000. We conclude, therefore, that some factor under control at A was not controlled at B—an assignable cause of variation has crept in, which unless located and corrected will **continue** to cause more points out-of-control.

It may be very difficult to assign causes for isolated points out-of-control, but as long as this condition exists, we are not getting the quality the process and equipment is capable of producing.



Symptom—Runs above or below.

(Rule of Seven—Grant, page 129).

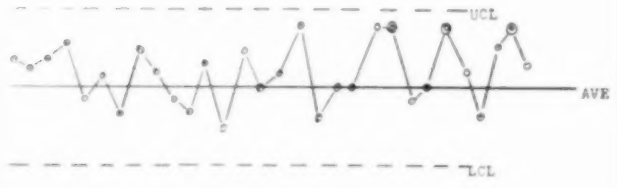
In section A-B control was good. Near B a process variable changed, and the process after B is definitely

operating at a new level.

This new level may be desirable or undesirable; in either case, now is the time to diagnose, correct or adopt the cause, because sooner or later some points will run outside the control limits. This is one of the nicest (and most common) inferences from the statistical method since it detects assignable process changes before serious trouble has occurred.

Incidentally, this thinking works as well in reverse. If you make a process change, you are not justified in concluding the product level has been changed until the product is out of control.

Chart Showing Changing Conditions



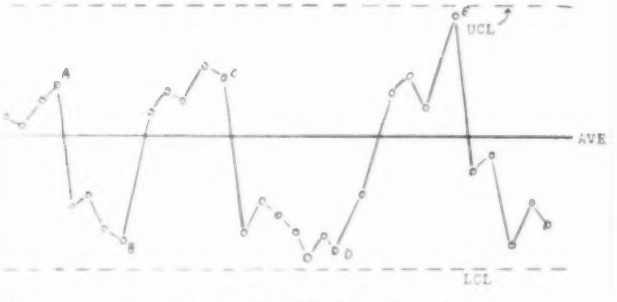
Symptom—Too many points near a control limit.

Non-normal distribution.

This is a more sophisticated interpretation of control charts than the simple interpretation of points outside the control limits. However, with 5 points out of 14 in the "two to three sigma zone" we would be wrong in saying an assignable cause of variation existed in the process not more than once in a thousand times. Obscure that this interpretation might be, it is extremely valuable in a carefully controlled process because it asks for corrective action long before sub-standard material is produced.

Look for a poorly trained operator, or one kettle not functioning like the others. Periodic depletion of feed in a continuous process could do it. These are all faults resulting in poorer quality.

Chart Showing Possible Over-Control



Symptom—Non-normal distribution, bimodal.

A good many things could result in this type of curve, one of which is process "over-control." A process is over controlled when corrections are applied on the basis of extreme values when those extreme values are actually perfectly normal to the process. Normal variations can be determined by holding everything under as close control at a constant level as possible. To correct for normal variations does nothing but superpose a man-made variation on one which already exists.

Below is the same data in which extremes were accepted without correction. Actually, it is unwise to change operating levels until several successive points are out of control, then if the cause can not be found, make an arbitrary process change. Even then, you will get into trouble if the unknown cause suddenly disappears.

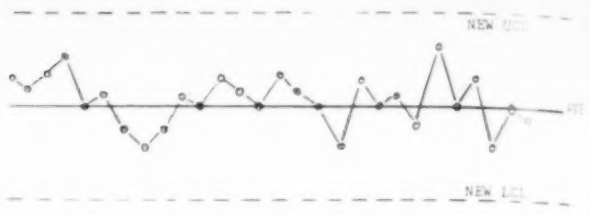
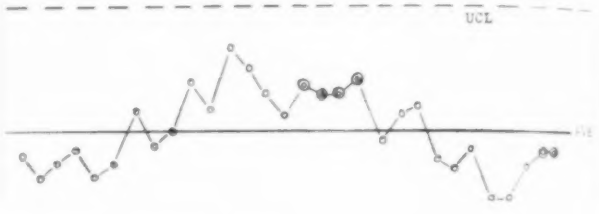


Chart Showing Cyclical Trends

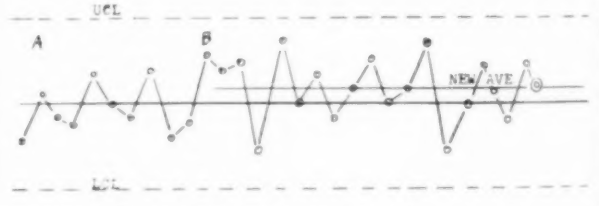


Symptom—Cyclical Trends.

We're stumped to explain this one, but we had to put it in because it is so common and because it wreaks so much havoc with product uniformity. In this example product uniformity is at least three times poorer than the process is capable of maintaining.

Slow changes in blended raw materials, due to pumping in variant tank car loads, could do it. So could cyclical supervisory pressure to produce higher quality. So could the slow unrecognized effect of time on operating procedures where these have not been pin-pointed to precise values.

Chart Showing Change in Process Level



Symptom—Runs above or below.

In addition to showing gross variations in quality which are generally obvious anyway, the control chart is a sensitive indicator of minute variations which could hardly be detected by any other method.

In the chart above, an assignable cause of variation entered at point B, shifting the average by a barely perceptible but truly significant amount. Perhaps someone changed the feed to a distillation column at B. In any case, a small but significant change in level has occurred.

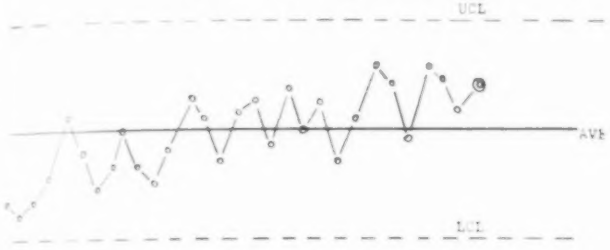
Careful watching for significant changes of level, and identification and adoption of causes leading to better quality is a major constructive function of control charts.

Other chart patterns indicating a significant change in level are as follows:

Points on one side of Average Line	Total Points
7	7
10	11
12	14
14	17
16	20

Incidentally, like all statistical techniques, infallibility is not guaranteed in borderline cases beyond certain limits. In using the above, in a very poorly controlled process you will make an incorrect decision not more than 11% of the time. In a well controlled process (normal distribution) the probability of making an incorrect decision will be reduced to 0.23%.

Chart Showing Trend



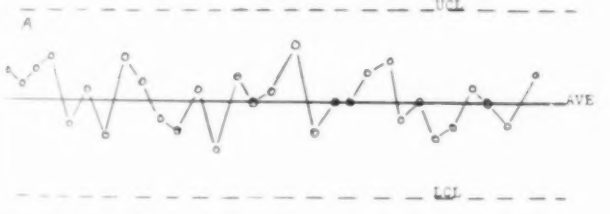
Symptom—Runs up or down.

In this chart, all points should be circled because a process is not in statistical control unless it is producing at a stable level of quality. Although it is obvious enough that a trend exists and that an assignable cause is producing it, it is not so obvious that if that cause were removed the finished quality would be (in this example) 30 to 40% more uniform.

Look for gradually changing raw materials, transient production standards or procedures, catalyst poisoning, or laboratory standard solutions gradually going off standardization.

See "Introduction to Mathematical Statistics," Hoel, P181, for table to detect runs up or down.

Example of Process Under Control



Symptom—None.

This is good control. By good control we mean:

(a) All process variables controlled prior to A were as adequately controlled through B.

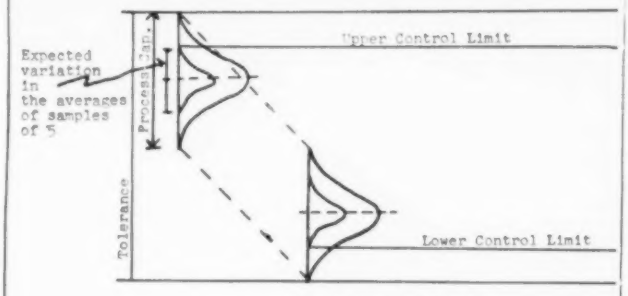
(b) Quality variation is completely random, centered about the average, free from runs (trends), and points are more dense near the average (normal distribution).

It does not mean the process can not be improved, you can always put in more precise pyrometers or automatic scales, but it does mean that with the process and the equipment we now have, we are doing a fine job. And it is unlikely we can do any better unless we have a new process, new raw materials, or new equipment.

Modified Control Chart

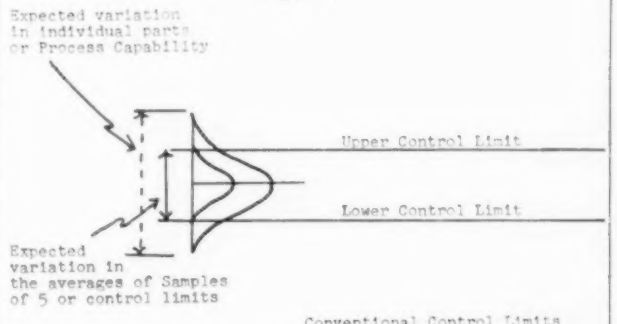
A variation on the Average and Range chart is the so-called "modified control chart", which is useful when the process specifications are fairly wide as compared with the process control limits. In using this type of chart we are primarily interested in those changes in the process which will result in the production of out-of-specification material. In using the modified control chart, the control limits are measured inward from the specification limits instead of outward from the process average as is the case with the average and range chart. Figures 6 and 7 show the amount of process variation permitted with the modified control chart as compared with the conventional type of chart.

Amount of Variation Permitted
By Modified and Conventional Charts



Modified Control Limits

Figure 6


Expected variation in individual parts or Process Capability
Upper Control Limit
Lower Control Limit
Expected variation in the averages of Samples of 5 or control limits

Conventional Control Limits

Figure 7

Of course, if the cost of controlling the process within narrow limits at a given average is negligible, the conventional control chart approach will result in a much more uniform product, and greater customer satisfaction. However, if this type of control is costly, and the customer can permit some shifting of process level, then the modified chart comes in handy.

Where and Why?

To date, the greatest application of control charts in industry has probably been by laboratory or inspection personnel, or by Research chemists and engineers who are interested in basic product improvement and development of new products. The control chart, however, is designed primarily for process control, and as such is most useful to the production man, right on the job. The control chart supplies information in a form which is most readily available for immediate action, and production personnel should be trained in the background and application of this information. To this end, the chart should actually be plotted by the operator, using data which he himself obtains, and giving him freedom of action based on the interpretation of the data.

Control charts supply an excellent means of recording routine quality data, and form a sound basis for performance review and quality improvement programs. The charts should be circulated freely within the organization, so that the various groups responsible for phases of the quality improvement function will be pulling in the same direction on the basis of the same information. In this way, control charts can help to reduce costs, increase quality yields and supply the consumer with a finer pro-

(please turn to page 30)

Heat Flow Through Plastics Materials

——a technique for solution of heat flow problems——

Victor Paschkis

Director, Heat and Mass Flow Analyzer Laboratory
Columbia University

Introduction

The manufacture of plastics is predicated to a large extent on heat transfer. This holds for the production of raw materials where polymerization is, at least in some instances, controlled by the heat withdrawal which limits the temperature rise caused by the exothermic heat of reaction. In the production of semi-finished goods, such as sheets, films, rods, and tubes, presses and calendars are but two examples of thermal processes. The whole field of molding and casting comprises thermal processes of softening the plastic and cooling it subsequently.

Yet, in the plastics industry this entire aspect has to date been handled as an art, finding solutions by trial and error.

In seeking these solutions accurate knowledge of the thermal aspect is usually bypassed: more or less heat is supplied, as the case may be, without that temperatures or heat quantities are known. The reason for this method of procedure is probably to be seen in the difficulty of either measuring or computing temperatures under the conditions prevailing in the field.

However, a technique is now available which overcomes these difficulties to a large extent and makes it possible to take guesswork out of some important parts of plastic manufacture. This very powerful technique has been proven valid in a number of fields other than plastics.

In the first part of this paper the technique is described, in the second part a few problems of the plastic industry are discussed in detail, and in the third part a summary of some heat problems in the plastics industry amenable to this kind of analysis is presented.

Also a brief review of work carried out in other fields will be shown.

I. Heatflow Computations By Electric Analogy

Heating and cooling can be studied by means of electric analog computers. This type of large scale computing devices is based on the identity of the differential equations governing the thermal problem and the equivalent electric circuit. For heat conduction, including convective heat transfer at the surfaces, the equivalent electric problem is that of a non-inductive cable.

From the basic equations the following list of equivalent magnitudes can be derived:

Heat System	Electrical System
Temperature	Voltage
Rate of Heat Flow	Current
Thermal conductivity	1/Resistivity
Thermal capacity (specific heat density)	Electric Capacity

Take the simple case of a rod, **Fig. 1**, in which some heat problem occur. The rod is insulated on the sides so that heat flow occurs only in one direction, that of the axis. In representing this rod, it is thought to be subdivided into sections or lumps (**Fig. 2**) and in each lump the thermal properties are considered concentrated in the center. Thus a circuit as shown in **Fig. 3** would be used.

The circuit is closed according to the prevailing thermal conditions, e.g. let the two ends of the rod face two bodies of air, each of which is at a different but constant temperature: such rod could then be thought of being part of a furnace wall. Between the air and the surface there is a resistance to heat transfer, which finds expression in a temperature jump between air and surface. The reciprocal of the resistance is sometimes referred to as heat transfer coefficient, or also as boundary conductance. These resistances (one at either end of the rod) are represented by electric resistances, as indicated by the dotted additions in **Fig. 3.** Similarly, the case of heat generation inside the rod, say by dielectric heating, can be represented by feeding current into each section of the rod (points A, B, C, D).

If heat flow occurs in two directions, a network as indicated in Fig. 4 is used, with two sets of resistors, one each for heat flow along each axis of an orthogonal coordinate system.

It is important to note that, in order to develop the equivalent electric circuit of a thermal system, only the

and the thermal properties need be known. Neither must a sample of the body be at hand, nor do its electric properties enter the procedure. The electric values in the circuit are computed entirely from shape and size and from the thermal properties.

It is not necessary to conduct the electric "computing experiment" in the same length of time as the heat phenomenon occurs: in designing the computing circuit a time scale can be introduced, making the electric computing experiment longer or shorter as the need may be.

The circuits as shown in **Fig 3** and **4** are quite simple. In order to solve expeditiously the more complex problems, an analog computer has been developed at Columbia University. Essentially, this computer consists of a large number of electric capacitances (total available capacitance 2000 microfarad) and electric resistance sections (more than 1250) so arranged that a large variety of circuits can be built in short time, power supplies and measuring devices.

The general layout of the laboratory is shown in Fig. 5. The "capacitance frames" C contain the individual capacitances, each of which has one pole grounded. The other pole is brought to a double outlet, permitting simultaneous inter-connection connection to an electric "bus". The "busses" are connected to the "main panel, M". Each of the 130 resistor sections on frames R consists of four decades, with a provision to insert additional resistors, if larger or smaller resistance values are required; in each section values from 0 to 1.111×10^6 Ohm can be set in 100 Ohm steps. The ends of each resistor section are brought to the "main panel."

For many problems, more resistor sections are needed, and therefore a resistor board R_2 **(Fig. 5)** was added, comprising 1152 resistor sections. These are arranged semipermanently in form of a network of 576 nodes. Provision is made to connect either a capacitance or a voltmeter or a power supply to any of the nodes.

Power supplies and instruments are concentrated on panel I ,while auxiliary equipment such as relays, input devices, etc., is portable and can be so placed as to permit short leads and simple connections.

II. Sample Problem

In order to illustrate the application of this method, one specific problem will be explained in some detail.

Determine the cycle time in injection molding of a tooth brush handle. For simplicity's sake, consider the cross-section to be rectangular; consider the length also sufficient to render end effects unimportant. Assume, moreover, that the filling time is short compared with the freezing time. Thus the thermal problem involved can be thus stated: What is the permissible number of strokes per minute in producing the handles?

The first question to be asked is at what temperature can the handle be ejected. Obviously, it is wrong to speak of "a temperature of the handle", since at all times the temperatures at different points of the handle are different. Say that a maximum temperature of the slowest cooling point is selected on the basis of strength of the material.

With this as basis, the "computing circuit" for the problem can be set up. This circuit consists essentially of four parts:

A The circuit representing the mold;

B,C Two identical circuits representing two handles; (the reason for using two and only two circuits will become obvious from the description);

D The circuit representing the cooling of the mold surface after ejection of the handle.

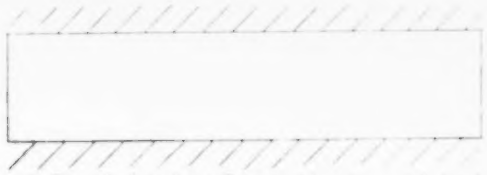


Figure 1. To calculate heat flow problem in a rod, insulated on the sides, by electric analogy, first (see fig. 2).

Figure 2. Divide rod into sections, as shown, and then set up (see fig. 3).

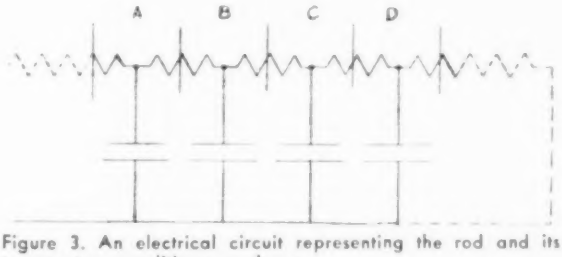


Figure 3. An electrical circuit representing the rod and its temperature conditions, as shown.

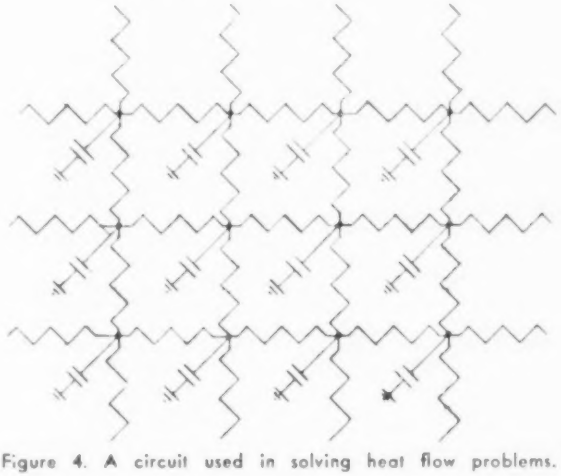


Figure 4. A circuit used in solving heat flow problems.

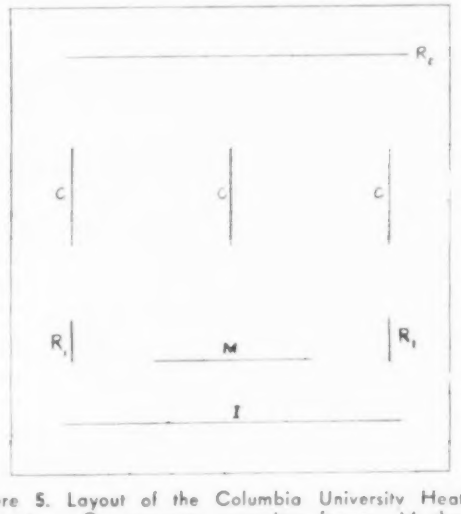


Figure 5. Layout of the Columbia University Heat Flow Laboratory. C represents capacitor frames, M the main panel, R resistor sections, I power supplies and instruments.

In **Fig. 6** the four circuits are indicated by boxes, marked A, B, C and D and a box S represents a power supply to charge circuits B and C to the voltage corresponding to the temperature of the plastic entering the mold. The three circles A, B and C represent three gangs of a switch, the common of each gang being connected to the corresponding circuits. Each switch has four positions, connected as shown. The wipers connected to the commons are shown in the "northwest direction", between two positions. The three wipers are moved simultaneously in a regularly intermittent rhythm.

In the first position (North) the mold and one plastic circuit (C) are connected; the plastic cools in the mold, while the other (B) is "preheated" (represented by circuit B being connected to the power supply). In the next position (East), the mold cools while both plastic circuits preheat; then circuit C discharges (plastic C cools) etc. If the interval between shots does not equal the dwell time, the rhythm of the switch is regulated accordingly. Circuits A, B and C are essentially of the same kind as those shown in **Fig. 3** and **4**, while circuit D is a resistor (representing the boundary or film resistance), connected to the ground potential, representing the air in the shop.

In order actually to compute the circuits shown, the following information would be required:

Geometry involved (dimensions of handle, of mold, etc.)

Cycle—dwell time in the mold; interval between shots.

Thermal properties:

Mold—conductivity; specific heat; density.

Plastic—conductivity; specific heat; density; heat of reaction, if any.

Cooling—if the mold is water cooled, quantity of water; entrance temperature of water. Temperature of the air in the shop; if blowers are used, velocity of air driven over open mold surface.

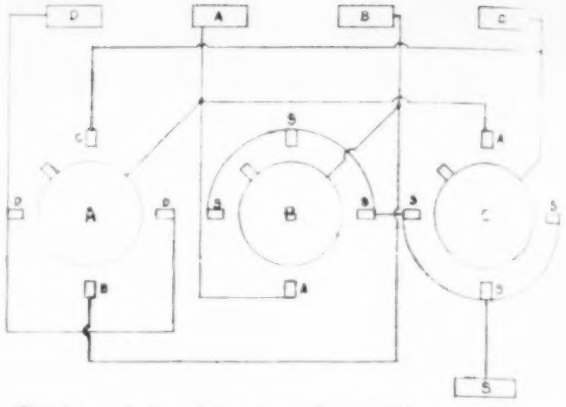
Temperature—entrance temperature of plastic.

Information to be gained from the computation experiments is either the temperature of the plastic upon leaving the mold and the temperature — space — time distribution in the mold, or (if the exit temperature of the plastic is prescribed) the cooling can be studied by making different assumptions regarding the coolant.

IV. Summary of Problems

In the plastics industry, a large number of heat problems occur. It is not possible to give here a complete list but the following items are given in way of example.

Manufacture of Raw Materials. Heating and cooling of the components and materials in continuous or batch operation. Temperature differences incurred and degree of uniformity with regard to time and to space.



Circuit used in solving heat flow problem to determine best cycle time for injection molding of a toothbrush handle.

Thermal Properties of Plastics. While work on the analyzer usually is predicated on the knowledge of the thermal properties involved, it can be used to determine such values as thermal conductivity, heat of reaction, etc. by combining certain actual experiments with analysis on the computer.

Half-Finished Products. (Rods, Sheets, Tubes.) Calenders can ferquently not be used over their entire length because of temperature differences at the ends. Causes and remedies for such differences present thermal problems amenable to analysis. Temperature distribution in presses and arrangement of heating channels in the plastics should be mentioned here.

Finished Products. Heating of preforms for thermosetting plastics. Presses: platen design, heating channels, and dwell time in the press. Extruders. Injection molding machines: design of the machine, design of nozzle and molds. Plastic films: curing time.

The electric analogy method has been used in fields other than heat flow over the last thirteen years. Among the problems handled, the following may be of interest.

Heating Up of Solid Bodies:

Temperature differences in the piece and rates of temperature change at different parts in the body.

Solidification of Materials:

Influence of thermal properties of casting and mold.

Significance of pouring temperature.

Heat generation by friction: between wheel and brake shoe (locomotive brakes), between brake lining and brake discs (airplane brakes).

Heat Exchangers:

Without heat storage;

Heat exchangers involving three fluids such as used in tonnage oxygen plants;

Heat exchanges with heat storage such as open hearth regenerators. Rubber curing time for automobile tires. Temperature distribution in blast furnaces.

Concept of Control Charts . . .

duct at lower cost, which is the ultimate goal of Statistical Quality Control.

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(2) Grant, E. L.—"Statistical Quality Control," McGraw Hill

(3) Mueller, R. K. — "Effective Management Through Probability Controls," Funk & Wagnalls

(4) Schrock, E. M. — "Quality Control and Statistical Methods," Reinhold

Plastic Auto Body Development

William A. Hermonat
Naugatuck Chemical Division
United States Rubber Company

Materials

A POLYESTER RESIN IS a thick syrupy liquid composed of a cross-linking monomer and a linear alkyd polymer. Catalysts with heat or a promotor transform this liquid to a solid, forming a hard and rigid thermoset material with a three-dimensional structure. Glass fibers, in the form of mat, cloth, or roving are saturated by the liquid catalyzed resin and formed into a rigid high-strength laminate by heat and moderate pressure. The lamination may require one-half minute to ten minutes to acquire a substantial cure. When a cure is obtained through the use of a promotor, the curing time is rarely below ten minutes and may be as long as several hours. A combination of moderate heat and promotor has been used to great advantage.

Fabrication

Fabrication techniques have followed many variations. Both temporary and permanent tooling have been used. By temporary tooling, we mean plastic dies, whereas permanent tooling refers to metal dies.

Plastic tooling is inexpensive, fast and easy to produce. Molds have been made of plaster, phenolics, polyesters and epoxys. The use of combinations are common. Each material has its own particular advantages and disadvantages.

Characteristics of Materials for Temporary Tooling

	ADVANTAGES	DISADVANTAGES
PLASTER	Familiarity Availability Inexpensive	Easily Damaged Porous Weak
POLYESTER	Tough Durable Easy to Use Strong High Heat Distortion	Shrinkage
EPOXY	Tough Durable Strong Low Shrinkage	Low Heat Distortion Somewhat difficult to use
PHENOLICS	Easy to Use Low Shrinkage Moderate Cost	Brittle Porous

Mold Preparation

Temporary tools require extensive mold care and preparation. They must be coated with wax and polished. However, this protective layer is not sufficient to completely prevent sticking of the laminate to the mold. Wax picked up by the laminate from the mold surface causes spot adhesion to the finished body. Polyvinyl alcohol is, therefore, sprayed on the mold surface and allowed to dry. It gives complete protection to both mold and laminate through a continuous and impervious layer of parting agent. The film is easily removed by washing with water.

Shellcoat

Today's automible possesses a very high quality finish, and the plastic auto body should also have this same high quality finish. Special precautions must be taken to prevent the appearance of a fiber pattern caused by heat or high humidity. The use of a resin surface layer (termed the "shellcoat") 10 to 20 mils thick on the outer surface of the laminate prevents the appearance of the fiber pattern. As developed by the Naugatuck Chemical Division, the shellcoat has built into it the necessary resilience to resist surface crazing. It was formulated with two additional features in mind. First, when the shellcoat is sprayed onto the mold surface it will not run. Second, a calibrated concentration of white has been placed in the shellcoat so that a layer of 10 mils or more will be opaque.

This surface can be finished by conventional techniques used for metal bodies to obtain a high quality finish.

THE HAND LAY-UP technique is the simplest approach requiring only a single-faced mold. The mold is prepared for lamination by waxing lightly and polishing to a high gloss. The mold is then sprayed with a continuous base layer of polyvinyl alcohol. After the parting agent is thoroughly dry, a 10 to 20-mil layer of the shellcoat is sprayed on the mold. Tailored glass fabric and mat are placed in the mold and saturated with catalyzed and promoted resin. The air is worked out with hand tools. After the laminate is cured it is removed from the mold and trimmed to the proper dimensions. Application of moderate heat will accelerate the cure.

The hand lay-up technique requires little equipment other than a mold. Because no additional tooling is required, it takes little time to start production. Rate of production, however, is slow. Maintaining uniform thickness is difficult. Variations of thickness tend to cause distortion of contours, decreased craze resistance and difficulties in assembling sections together. The glass content rarely goes above 25%. Usually, the air side of the laminate is rough, at times requiring some finishing. Glass cloth is nearly always needed to acquire the proper strength.

VACUUM BAG molding requires additional auxiliary equipment and overcomes some of the difficult points of hand lay-up. Mold preparation is essentially the same, requiring wax, the base polyester resin, and the shellcoat. Tailored glass mat will usually suffice. The mat is then saturated with resin, one and one-half times the weight of the mat. A layer of polyester resin film is placed over the laminate and secured air tight at the perimeter of the mold. The vacuum is then applied giving a molding pressure of 10 to 14 psi.

Vacuum bag-molded pieces will be approximately 40% glass with much less tendency towards resin-rich areas. The thickness of the piece is more easily controlled. The somewhat rough back caused by folds in the bag may require additional finishing of the piece.

PRESSURE BAG molding is essentially the same technique as vacuum bag molding, and higher pressures of 30 to 40 psi have been used.

Considerable improvement in bag molding has been made through the use of a male plug. The male plug is a thin shell mold which follows the exact contours of the back of the part to be laminated. It may be made of a

(please turn to page 45)

This paper was presented at the April, 1954 meeting of S.P.E. and is printed with their permission.

PLASTICS AROUND THE WORLD

BELGIUM

MATIERES PLASTIQUES ET RESINES SYNTHETIQUES

No. 71, July-Aug., 1954

Abstracter: Alfred P. Daignault

ETHYL CELLULOSE, from La Bellignite, France: pp 7-8

This article discusses the characteristics of and some of the applications of ethyl cellulose.

NEWS OF THE WORLD: pp 9-13

France—
1. Renauet plastic sport car to be introduced in U.S.
2. Production of nylon stockings reaches new high in France.
3. Use of Plexiglas in phosphate plants.
4. Products of Societe Pechiney, vinyls, styrene, polyethylene.
5. Laminated plastic pipe.

Germany—
1. Increased production of PVC.
2. New production facilities for synthetic fibers.

U. S. A.—
1. Various new plastic applications.
2. Use of vinyl signs in industrial plants.
3. Growth of reinforced plastics industry.
4. Anti-corrosive coating.

Great Britain—
1. Distribution of Dynel in Great Britain.
2. Announcement of bulletin on use of silicones in industrial motors.
3. Announcement of bulletin on adhesives for transparent film.
4. Plywood pipe.

Norway—
1. Use of cod residue in production of plastics.
2. Use of fish bones in production of plastics.

NEW FILMS FOR PACKAGING, from Revue des Products Chimiques, Paris: pp 13-14

A general discussion of films for packaging with special emphasis on combinations of cellophane and polyethylene.

PHENOLIC RESINS FOR GRINDING WHEELS

Method and advantages of making grinding wheels with this type of resin is described.

Announcement of the 27th Congress of Industrial Chemistry.

PLASTIC MATERIALS IN HOME BUILDING AND DECORATING

A. Klegecell—A multi-cellular plastic base material which can be used in joining, weatherstripping, accoustical paneling as well as in decorative paneling.

B. Illustrated Plastic Applications—
1. Vinyl wall tile.
2. Vinyl counter tops.

MATIERES PLASTIQUES

No. 70, May-June, 1954

MIXTURES OPEN THE DOORS OF THE FUTURE IN TEXTILES, from Plastiques Informations, Paris: pp 7-9

This article discusses the impact of mixtures of natural fibers and man-made fibers on the textile market. Applications of various mixtures are listed and the economic aspects explored.

USE OF PLASTISOLS IN AUTOMOBILES, from Revue des Products Chimiques, Paris: pp 10

The use of vinyl plastisols for coating of cushion springs and as bumper guards is the subject of this article which also discusses the production methods used in these applications.

NEWS OF THE WORLD: pp 11-14

Germany—
1. Creation of a new Plastics Institute.
2. Croning method of shell molding.

France—
1. Wood waste panels.
2. New production facilities of Rhone-Poulenc.

Great Britain—
1. "Hermetal" for sealing metals.
2. "Arabol" to protect glass fiber insulation.
3. Packaging of adhesives in polyethylene.
4. Use of synthetic resins in airport runways.
5. Use of PVC sheets in railroad control centers.
6. Polyethylene insulated wires.

United States—
1. Industrial use of "Thermoglaze" sheet and film.
2. Use of phenolic resins in controlling evaporation of gasoline.
3. On the spot construction of pipe lines.

CADARISOL & CADATHENE, two new Belgian packaging materials: pp 14-16

Cadarisol represents a paper or cardboard packaging material impregnated with thermoplastic resins while Cadathene is a polyethylene laminated paper or cardboard material. A list of suggested applications is included.

PLASTIC MATERIALS IN HOME BUILDING & DECORATING

A. Advantages of and uses for printed vinyl film in the home.

B. Carpets of woven vinyl film (illustrated).

C. Use of polyester resins in construction of light weight cupolas (illustrated).

D. Illustration of flexiglass ceiling.

PLASTICS IN PACKAGING & DISPLAY

An illustrated section showing various plastic applications such as acetate sheeting for packaging, a cardboard tube with a polyethylene inner liner for tooth pastes and cosmetics, and acrylic and vinyl displays.

PLASTICS AND ANATOMY, from Plastiques Informations, Paris

This illustrated article describes the use of vinyl plastisols in making life like models such as those used in medical schools, etc.

BRAZIL

REVISTA BRASILEIRA DE PLASTICOS

Vol. 1, No. 11-12, Nov.-Dec., 1953

Abstracter: Louis A. Helwich

NEW PLASTIC SUBSTITUTE OF BLOOD: Page 4-6

(A translation from Popular Science). The story of polyvinyl pyrrolidone, a substitute of blood plasma, its invention in Germany and further development in U.S.A. is told.

RHODIALITE: Page 8-12

A cellulose acetate molding powder of Brazilian production is described. Details about its processing by injection molding, compression molding and extrusion are given.

PLASTICS INVADE THE AGRICULTURE: Page 14

The "Krilium" plastic soil of Monsanto is described.

OUR VINYL PROSPECTS: Page 33

A review. There are four vinyl fabricators operating now in Brazil, using imported resins. The company Electro Cloro in Sao Paulo is installing a vinyl resin production plant. The output for the year 1954 is to be 200 tons.

REVISTA BRASILIERA

Vol. 2, No. 1, January, 1954

PLASTICS, THEIR TECHNIQUES AND PROBLEMS: Eric Jeanrenaud, Page 8-10

The compression molding is treated from the theoretical point of view.

PARTS FOR FREEZER UNITS: Page 18

A review. Refrigerator parts are produced in Brazil to some extent. The raw material situation can be seen as follows: Polystyrene is produced in Brazil in excess of the demand. Phenolic resins are in sufficient quantity same as cellulose acetate. Urea powders cover only about 15% of the domestic consumption. All other resins must be imported.

★

GERMANY

DER PLASTVERARBEITER

Vol. 5, No. 5 and 6, May-June, 1954

Abstracter: Ernest C. Bernhardt

REPORT ON THE PLASTICS SECTION OF THE 1954, HANOVER INDUSTRIAL FAIR.

Exhibits of various plastics material supplies and machinery builders are described. Illustration of plastics processing machinery are included.

Vol. 5, No. 6, June, 1954

TECHNIQUES FOR FLAME-SPRAYING AND FLOTATION SINTERING OF PLASTICS: by G. Gemmer

The paper discusses in detail: (a) The preparation of the metal surface for the application of the resin; (b) Flame Spraying; (c) Flotation Sintering. In the flotation sintering process the resin is used as a finely divided powder which is held in a container with a porous ceramic bottom surface. Air is passed through the ceramic bottom into the container, and causes the resin particles to float and be suspended in the air stream. The resin-air mixture assumes the characteristics of a liquid.

The metal object to be coated is preheated to a temperature above the melting point of the resin, and dipped into the air-suspended resin for a set period of time. A homogenious coating results.

In a modification of this process the metal object may be coated with a parting agent before being heated and dipped into the resin-air suspension. In this way the plastic can be stripped from the metal form, and simple shapes can be formed quickly and easily.

Vol. 5, No. 7, July, 1954

"CUSHIONED" INJECTION NOZZLE: by H. Spies, p 212

An injection nozzle floating in a sleeve and pushed forward against the mold by the melt pressure in the heating cylinder is described. This device is designed to reduce the care necessary in setting up the machine and adjusting the fit of the nozzle against the mold. Patents are applied for.

NEW RAPID INJECTION MACHINE WITHOUT RAM: by H. Spies, p. 215

A new injection machine is described in which the mold as it is clamped, pushes against the injection nozzle. The nozzle slides in a sleeve, and can be pushed into the heating cylinder, the movement of the nozzle in the sleeve causes a displacement of molten polymer through the nozzle into the mold. This system utilizes the clamping pressure to force material into the mold. The pressure loss encountered across the torpedo by conventional ram injection is eliminated. Patents are applied for.

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PLASTE UND KAUTSCHUK

April, 1954

Abstracter: Walter Brenner

UNSATURATED POLYESTERS AND MINERAL FIBERS: Dr. E. Ulsperger

This article reviews the chemistry of unsaturated polyesters and describes the present fabricating techniques employed industrially for the production of glass laminates. Special emphasis is given to present and potential applications in aircraft, railroading, piping and in the electrical field. A list of the physical properties of 26 various polyester condensates is included.

CONSTITUTION, PROPERTIES AND APPLICATION OF EPOXY RESINS: H. Jahn

The paper is concerned with a description of present and anticipated applications for epoxy resins in casting and laminating as well as in adhesive applications. Some attention is also given to the use of epoxy polymers as heat stabilizers for vinyl resins.

POLYISOBUTYLENE RUBBER: J. Michalowska

Considerable detail is given on polymerization techniques for the production of isobutylene rubber. This emphasis being placed on the effect of such variables as temperature, purity, etc., under properties of the resulting polymers. Applications for polyisobutylene rubber are discussed briefly.

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KUNSTSTOFFE

Vol. 44, No. 7, July, 1954

Abstracter: Anne Schwend

SYNTHESIS OF NEW LIGHT-SENSITIVE PLASTICS: Dr. G. A. Schroeter and P. Riegger

This report from the laboratories of the Feldmuehle Papier-und Zellstoffwerke AG., at Wesseling near Cologne, deals with the attempts to synthesize plastics holding as main valence a high molecular organic carrier system, such as for instance the chain of polyvinyl alcohol, and as medium of light sensitivity iso- or heterocyclic annular systems with at least three lineally linked hexagonal rings (anthracene, acridine, phenazine). The first photochemically active plastic material of the above structure is 9-anthracene aldehyde acetal via polyvinyl alcohol. It is understood that polyvinyl acetate would do as base, too. This acetylized, high temperature-resistant white powder dissolves in aromatic hydrocarbons, chloro-benzol and aliphatic chlorohydrocarbons. Solutions will leave clear films upon evaporation. Tests prove that a film produced from a 50% acetylized polymer and a 5% solution of chloro-benzol becomes insoluble in benzol after a one-minute exposure to an arc lamp. A number of similar tests showed the same results; hence, it is concluded that the photochemical reaction consists in an increase of the molecules through interlacing of the added anthracene molecules. The same as anthracene dimerizes under the influence of light, suitably oriented 9, 10-carbonic atoms within the anthracene structure form bridges between the macromolecules.

Metal printing plates coated with this new plastic material proved to be still usable after a one-year storage. Attempts to etch the material with the help of a suitable grating negative under the arch lamp and dissolving those parts covered up during exposure by an organic solvent yielded favorable results.

In the future particular attention will be paid to the interrelation between interlacing, dilation and the effect of plasticizers, since it seems

now possible to effect a structurally defined chemical bridging of molecules with the help of a simple light shock of the longer wave ultraviolet.

AGING OF PLASTICS UNDER THE INFLUENCE OF LIGHT:

Hildegard Raeithel

The increasing adoption of plastics packaging materials required a survey and coordination of pertinent information which is presented in this article.

The choice of the right stabilizer is dependent on familiarity with all factors influencing the stability of the plastic materials, such as the content of foreign matter in the monomer, all strictly physical influences during processing (high pressure, high temperature, contact with oxygen during calendaring at highly elevated temperatures, etc.) and the chemical additions for plasticizing and stabilizing, so that it would, in the end, only need the influence of light to accelerate a destroying action. According to present experience immediate destruction of plastics is only caused by short-wave ultraviolet up to 3400 Å (Ecerton photolysis). The energy supplied above a certain frequency is sufficient to tear apart macromolecules, thus causing a decrease in the degree of polymerization and the mechanical properties connected therewith. Reference literature is cited for the influence of light frequencies, processing methods and the chemical process of destruction initiated by light influence for various groups of plastics.

THE STRUCTURE OF CRYSTALLINE HIGH POLYMERS:

H. A. Stuart

Our knowledge of the structure of crystalline high polymers is still very restricted. This article, therefore, tries to bring some light into this matter by showing fundamental points in thermal treatment, modifications of the original structure caused thereby and the results of tests on the formation of spherulites and fibrillae. The features of the melting process, particularly the final melting stage: expansion of the molecular chain network and its slow modification by the melting process as well as the changes in the state of order taking place below and above the melting point, are discussed in detail. Some forms of molecular structure connected with the crystallization process are described.

Tests to determine the dimensions of the crystalline amorphous structure surprisingly showed the appearance of long periods which are highly dependent on tempering and swelling processes as well as elongation. Tempering does not simply cause an increase and growing-together of existing crystalline fields but, evidently, a complete change in structure, i.e. melting of the original crystalline fields and formation of new ones: the higher the tempering process, the longer the periods, the better the lateral structure and the smaller the absolutely crystalline share. It follows that each crystalline field will be surrounded by an increasingly amorphous structure, thus balancing itself with an increasingly stress-free and disorderly surrounding, signifying that the melting point becomes higher and higher.

First results of investigation of the formation of spherulites which evidently only form upon slow cooling down of the melt, depending on the maximum temperature of the melt before cooling, are enlarged upon. It seems impossible to cause the formation of spherulites by tempering, even in the melting stage, when the material is free of same. Evidently one of the prerequisites is that the chains retain their movability long enough to such an extent that they are able to adapt themselves to higher units. It is still an open question whether, generally, the formation of fibrillae represents the first step in textural structure, under which conditions they will form and whether spherulites will again form from fibrillae using the latter as sub-units.

8th CONFERENCE OF THE "SYNTHETICS AND RUBBER" GROUP OF THE SOCIETY OF GERMAN CHEMISTS

Interests in common to both the "Synthetics and Rubber" and the "Pigments and Paints" Groups were discussed at this meeting. Part of the following papers will be presented in Kunststoffe shortly:

Dr. B. Cyriax: The Lacquer Industry and Development of Plastics.

Prof. Dr. Karl Hamann: Tendencies of Development in the Lacquer Industry.

Dr. E. Mueller: Last Developments in Vulcollan (Rubber-elastic plastics on polyester diisocyanate basis).

Prof. Dr. Skraup: About the chemism of accelerated vulcanization.

Prof. Dr. Jenckel: Effects on Plasticizers.

GERMAN STANDARDS

The former standard DIN 7708 "Thermosets", introduced in December 1944, shall be sub-divided into various sheets, of which Sheet 1 shall contain general information on plastics, molding compounds, thermoplastics, etc., and Sheets 2 and following shall separately deal with a certain group of compounds only in order to facilitate the description of inherent properties and typical characteristics.

Sheet 1 is presented laying down the definitions for plastics, molding compounds, thermosets and thermoplastics as well as moldings made therefrom.

Sheet 2 lays down the characteristics of phenoplasts, pure or with fillers or other additions, comprising all thermosets on the basis of phenolics.

Sheet 4 introduces the characteristics of cold molding compounds and bituminous compounds.

DIP PLUNGER TRANSFER MOLDING: W. Woebken

A new form of transfer molding characterized by lower injection pressures, lower plastics consumption due to abolition of runners and sprues and differing from normal transfer molding in that the front surface of the injection plunger forms part of the mold in the forward position. The injection nozzle, usually separating the mass chamber and the mold cavities, is eliminated. The danger of faulty weld lines is said to be eliminated, although application of this type of transfer molding is limited to single cavity molds.

POLYESTER CASTING RESINS AND LOW PRESSURE PHENOLIC MOLDINGS: D. S. Mahon

A paper presented at the 1953 convention of the Swedish Plastics Society, dealing with the potting of biological specimen and highly sensitive electronic units, the manufacture of dies for sheet-metal working from glass or asbestos fibre reinforced polyester resins, as well as with the use of phenolics for the production of laminates under atmospheric pressure. This paper constitutes a report from the laboratories of Bakelite Ltd.

EXTRUSION OF RIGID PVC TUBES: E. G. Fisher

Part 2 of this paper (for part 1 see April 1954 abstracts) describes in detail the design features required for the extrusion die, die head and take-off equipment.

KUNSTSTOFFE

Vol. 44, No. 8, August, 1954

MOLDING COMPOUNDS FROM WOOD CHIPS: E. J. Ritter

Prompted by the rapidly increasing use of molding compounds from wood chips, the author does not only give a survey on existing methods for gaining and properly preparing the wood chips and filling them with phenolic or urea resin binders, but also makes suggestions for the standardization of wood chips and the corresponding binder ratio. Some practical advice for the setting up of a plant for preparation of the molding compounds from any desired size of wood chips and subsequent molding of plates for various industries is offered.

BIGGEST GERMAN INJECTION MOLDING MACHINE:

Eng. Hans Plum

Description of the biggest injection molding machine so far built in Europe, made by Becker & Van Huellen at Krefeld, for a capacity up to 2750 grams (6.3 lbs.) per shot. This horizontal machine is equipped with each four tie bars both on the injection and closing sides, overall length 8555 mm, width 1750 mm, height 2430 mm, total weight 32 tons without drive. Here is some more data:

Closing pressure: 800 tons; Closing and opening speeds between 150 and 500 mm/sec; Adapter plate area: 1140x1140 mm; Automatic actuation of ejector pins; Capacity of plasticizing cylinder: 100 kg/h; Band heaters around plasticizing cylinder; Temperature control by regulating transformers; No dead ends in plasticizing cylinder; No oozing out of liquid plastic from slide nozzle between shots; Lower end of hopper provided with quantitative feed timers exchangeable against weigh feeding device; Water hydraulic drive.

CONTRIBUTION TO THE FRACTIONATION AND VISCOSITY OF UREA FORMALDEHYDES:

Dr. R. E. Vogel

Due to the presence of loose linkages, difficulties in the investigation of urea formaldehyde condensates were overcome to a large extent by methylating the product after condensing the resin in the autoclave under constant stirring and pressure. Fractionation was effected by dissolution in ethanol water and precipitation with methanol, and subsequent drying. The precipitated products were always below 50% of the original quantity, caused by the lyophilic attitude of the urea resins. Measurement of viscosity clearly shows values above 0.0025 for ideal balls so that obviously macromolecules have a three-dimensional shape (close to uniform). Condensation, not association, governs the formation of resins. Glycogen hydrolysis shows the same viscosity for molecular weights between 1,530,000 down to 20,300. Observations in the electronic microscope identify the macromolecules as ball shaped. Urea resins show an even greater solvent binding strength than glycogen and other ball shaped proteins. Interlacing of urea formaldehyde molecules takes place very rapidly and is directly dependent on the pH-value and the temperature.

THE EFFECT OF TOP COATINGS ON THE TACKINESS OF ARTIFICIAL LEATHER: H. E. Frey

This article describes in detail a new method found for the determination of the degree of tackiness or dryness respectively of artificial leather. The results are reproducible within ± 10%. A specimen is inserted into a small metallic vessel and glass pearls of .20 to .25 mm in diameter are being pressed on in the drying chamber at various temperatures. Specimen of the film are weighed with and without glass pearls after having assumed room temperature again. Top coatings reduce the stickiness of films or artificial leather more or less depending on the temperature they are exposed to. Polyurethane coatings proved to confer absolute dryness to films, also when exposed to great heat or cold.

MANNER OF REACTION AND IDENTIFICATION OF POLYVINYL AND POLYACRYLIC COMPOUNDS: H. Rath and L. Heiss

To facilitate the identification of polyvinyl and polyacrylic compounds for the user, the authors have worked out a method of analysis. The natural reaction in polyvinyl compounds to form polyenes in the presence of heat, light exposure or exposure to varying climatic conditions, is being induced by means of alkali agents. According to the lengths of the conjugated chains that are formed, the material will take on a specific colour from which again conclusions as to its ingredients can be deducted. Some polyvinyl compounds which cannot be identified when using alcoholates as split-off-base, such as polyvinyl leather, may be converted into polyenes and analyzed with the help of phenyllithium. Identification and tracing of polyacrylic and polymethacrylic acid esters is feasible by converting them into carbinoles by means of phenyllithium analogous to the manner of reaction of low molecular esters. Experiments necessary for the above investigations are laid down in detail and comprise a number of qualitative and quantitative methods of determination.

FOUR-ROLL (700 mm) PRECISION CALENDAR

Hermann Berstorff Maschinenbau-Anstalt GmbH, Hannover, have developed a four-roll precision calendar each roll of which is equipped with a variable DC motor acting through gear transmission. Motor and gear transmission are built into an entirely closed oil-tight casing. The four DC motors are flanged to the gear transmission casing which is equipped on the opposite side with four drive shafts for direct coupling to the four rolls through universal joints. These allow an adjustment of the fissure between the rolls up to 20mm as well as slantwise setting of the lowest roll. Transmission of power is absolutely free of vibrations and shocks. Roll diameter is 700 mm, maximum length 1850 mm. This machine is meant for calendaring work in the caoutchouc industry as well as for drawing of plastic films.

GERMAN STANDARDS

Continuation of the last abstracts of drafts for new standards:

DIN 7708, sheet 6: PVC thermoplastic molding compound type P 601 without plasticizer on the basis of the emulsified polymerizers of pure vinyl chloride.

DIN 7708, sheet 7: Cellulose acetobutyrate injection molding compounds with a content of at least 40% in butyric acid, plasticizers and eventually dyes and pigments for injection molding, extruding and compression molding.

INJECTION MOLDING OF POLYETHYLENE: Frith Schaupp

Points to be observed upon injection molding of polyethylene in contrast to polystyrene are discussed.

Although polyethylene could be molded already at temperatures app. 40°C below the molding temperatures for polystyrene, it is advisable to use temperatures 20 to 80°C above those for polystyrene in order to obtain higher brilliance of the molded parts, greater transparency and higher mechanical strength. Ball check nozzles should be used to prevent drooling of material during molding cycles. The specific pressure of the plunger on the granules may be reduced to one half to one third of that for polystyrene, thus eliminating the danger of flash. A reduced injection plunger pressure does not entail a reduction of the mold closing pressure which must be kept the same as that for polystyrene. Shrinkage may be cut down to .3% when uniform working conditions are maintained. Heating of mold prior to injection and subsequent cooling to keep the inner surfaces of the mold at a constant temperature between 40 and 70°C will pay off in smooth molded surfaces of the parts. Sprue diameters may be kept 30% lower than those for polystyrene. Simple stripping of tubular parts, f.i., by ejector pins is not sufficient but should be supplemented by disk-like ejectors or compressed air blowers for blowing out of parts.

PRINTING ON PLASTIC-COVERED FABRICS AND FILMS: Ingvar Carlson

The characteristics of rotogravure, process, blotch and transfer printing are discussed as well as the features of printing machines, take-up equipment, drying tunnels and dies used.

SET SAIL FOR ATLANTIC CITY

Eleventh Annual Technical Conference

January 19, 20, 21, 1955

Chalfonte-Haddon Hall Hotel

GREAT BRITAIN

BRITISH PLASTICS

Vol. 27, No. 8, August, 1954

Abstracter: E. A. J. Mol

INCREASING USE OF PLASTICS FOR ELECTRIC SHAVERS. ANON. pp 298-301

Sales of dry shavers are expected to top $100 million in 1954 in U. S. A. alone and therefore offer substantial prospects as an outlet for plastics. Plastics are used in various components such as: Urea-formaldehyde resins (case and cover), polystyrene (hair pocket), acrylics (case, cover, hair pocket, head guard), vinyls (cord, plug, starter wheel, head barrier), cellulose acetate (cord retainer), nylon (bobbin, contact lever insulation, rotor shaft insulator, oscillator shaft bushing and sleeve), phenolics (gears).

SOME PROBLEMS IN THE DISPERSION OF PIGMENTS FOR PLASTICS: Paul Lowe, pp 304-306

The pigmentation of plastics has its own peculiar problems, many of which up to now have not received the scientific attention they deserve in view of the fact that color is a very important sales factor in plastics. As an example the problem of the evaluation and dispersion in the fineness-of-grind gauge is discussed. This method has to be complemented by microscopic evaluation and paper filtration. Finess of dispersion has a considerable influence on color and hue. Chemical class and type of the pigment are very important in their effect on dispersability. Carbon black is an especially difficult pigment. It is not only hard to disperse but shows considerable variation in "blackness". Other pigments may need special stabilizers to prevent flocculation.

STABILIZERS FOR VINYL POLYMERS, METALLIC COMPOUNDS OTHER THAN SOAPS: H. Verity Smith, pp 307-311

This is part 4 of a series but the title of this part does not cover the subject as only organic stabilizers are dealt with.

Discussed are: Amino type stabilizers (amines, imines, imides), both mono-and polymeric, Epoxide stab., Epoxide plasticizer-stabilizers, Phosphites, Esters and of course the inevitable miscellanuous group. Many interesting details about action and peculiarities are given together with the proprietary brand names. It is important and significant that a great number of German products are mentioned.

A STUDY OF THE INJECTION MOLDING CYCLE FROM AN ENERGY VIEWPOINT: H. L. Toor, pp 318-325

Here is a new and very interesting approach to the analysis of Injection Molding, the article is well worth reading. Although some molding experts' ideas may differ in detail from the authors' explanations, many interesting conceptions are presented.

Practically all the energy supplied by the plunger is converted into heat by the end of the molding cycle and will generally be an appreciable fraction of the total heat supplied to the polymer (up to 40%). The largest conversion of mechanical energy into heat takes place in the gate where temperature rises due to frictional heat may exceed 20°C. (for polystyrene). The author analyses the injection molding cycle in five steps:
a. Compression in the cylinder.

The temperature rises (over the temp. reached by heat conduction from the hot cylinder wall)
b. Flow through gates and runners. Again the temperature rises, this time by a much larger margin.
c. Compression in the mold. The temperature rises some more.
d. Holding time or curing step. Additional polymer flows into the mold, the temperature rises again, thanks to frictional heat.
e. Reduction of the plunger pressure, the polymer starts to flow back until the gate is frozen. The expansion makes the temperature decrease although again friction in the gate may partially compensate this.

Formula, relating the various forms and conversions of energy are given by the author together with numerical examples of the heat history in the five molding steps.

Pin point gating is discussed as a special case, in general a pin point gate requires more energy from the plunger which energy, of course, is for the greater part converted into heat to increase the temperature of the melt. From the numerical examples given by the author, it is important to note that kinetic energy plays a very major part and can be neglected in virtually all cases.

PLASTICS

July, 1954

Abstracter: A. T. Rexer

MOULD MAKING BY SPRAYING WITH LOW MELTING POINT ALLOYS: pp 215 to 216

This article describes the use of bismuth-based low melting point alloys in the production of moulds which are suitable for short runs and for low-pressure, low-temperature work.

PLASTICS IN THE SERVICE OF MAN: pp 218 thru 221

A pictorial review of high quality units moulded or otherwise fabricated in Great Britain for commercial vehicles.

HANOVER 1954 GERMAN INDUSTRIES FAIR: pp 227 thru 230

A review of the Hanover Fair illustrates the remarkable recovery of West Germany in the field of plastics machinery and materials.

MANIPLASTICS TWO-INCH EXTRUDER: pp 241 thru 243

This article incorporates notes and illustrations on a new plastics extruder.

PLASTICS

August, 1954

PROGRESS IN POLYTHENE BOTTLE MANUFACTURE: pp 250 thru 252

This article describes the semi-automatic and automatic Shipton machines which are used in the manufacture of blown polythene bottles.

VACUUM FORMING DEVELOPMENTS IN BRITAIN: pp 253 thru 254

A description of some of the developments in the application of vacuum-formed articles.

PLASTICS IN THE SERVICE OF MAN: pp 256 thru 259

An illustrated review of high quality units moulded or otherwise fabricated in Great Britain for household equipment.

PULSOMETER VACUUM FORMING MACHINE FOR THERMOPLASTIC SHEETS: pp 274 thru 275

An illustrated article describes a new twin-platen vacuum-forming machine manufactured by the Pulsometer Engineering Co.

HULE MEXICANO Y PLASTICOS

No. 103, August, 1954

Abstracter: John B. Ballard

POLYVINYL ACETATE EMULSIONS WILL BE PRODUCED IN MEXICO—Editorial page 7

Celanese Mexicana, S. A., has announced that it will soon be ready to furnish emulsions of polyvinyl acetate to the Mexican market. These materials will be used in the textile, leather, and paint industries.

SET SAIL FOR ATLANTIC CITY

SPE TECHNICAL CONFERENCE

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

"It is the freedom to disagree, to quarrel with authority, in intellectual matters to think otherwise, that has made this nation what it is today." Dr. James B. Conant

PYROMETERS

The story of injection molding is intimately connected with pyrometers. Originally Foxboro Pyrometers were mostly widely used in the late 30's. These mechanical type instruments were largely replaced by the new mercury switch type Bristols from 1940 on. Both these instruments were sold largely on specifications set by the machinery people and not the injection molder. Around 1945 Wheelco introduced a line of proportioning controls giving ever closer control of cylinder heat. In 1951-2, Taco-West brought out a new instrument, much smaller, and of highly simplified design, with plug-in components, that has attracted much interest.

We often tend to overlook the rapid improvement and progress made in pyrometer controllers since 1945. There have been cases where old instruments have been compared to more modern ones with definitely unfavorable results. Since modern thermoplastics require ever more critical controls, it has become a case of modernize or replace, because it has been shown that a program of pyrometer overhaul and modernization is an excellent investment. Wheelco has instituted a program whereby for a comparatively modest cost you can have your oldest instrument modernized with late-style plug in components, and come up with a pyrometer that will perform with the best 1954 models. The company is to be congratulated on taking such a helpful stand.

HEATING CYLINDER REPAIRS

In the past year we have been repairing an average of one heater a week. In 41 out of 52 cylinders overhauled, guess what has been the trouble? Broken spreaders? Leaks? Bad Joints? No—it has been metal and foreign objects. One cylinder from the west coast set some kind of a record with over 1½ pounds of tramp metal being taken from it, including ball bearings, nuts, bolts, and screws. Other objects we have found inside heaters include copper wire, brass rods, pipe stems, electric plugs and other unrecognizable parts of bakelite, cigarette lighters, coins, metal chips, tinfoil and other materials definitely not thermoplastic in nature.

Now we have not been able to determine if the material people put these objects in their powders to make them mold better, or if the molder himself adds them to improve the flow characteristics, but wherever they come from we can report that they are NOT suitable for molding, and definitely should not be specified for most molding jobs!

Ontario Discusses Reinforced Polyesters

R. K. Buhr

The Ontario Section of the SPE held its first meeting of the current season on September 21st at the St. Regis Hotel, Toronto, Ontario. This was the best attended meeting this year — 65 being present.

Our speaker was Mr. Morgan Keddie of Polyfiber Ltd., Renfrew, Ontario speaking on glass reinforced polyesters. Mr. Keddie described the method of producing continuous, strong glass filaments, whose diameters were related to the speed with which threads of glass were drawn from the melt. Roving is usually chopped up to make preforms, which are mats made in the exact shape for use. Mats are available chemically bound, as with styrene, or mechanically by stiching. Woven fabrics are made from twisted fibers woven on textile machinery, and are available in many strengths, weights and thicknesses and up to 144 inches wide.

Resins are many and varied, usually in liquid form, but there are powdered forms which are liquefied by adding styrene monomer. Viscosity is important and must be adjusted to suit the job. Rate of cure and exotherm must be kept under control. Self-extinguishing and light stable resins are available.

The making of structural, chemically resistant tanks and filter plates, pipe, boats, radomes and car bodies was discussed and the speaker stressed the need for engineering the materials to the application. Of interest was the description of an 80-foot diameter domed structure made from triangular glass-reinforced panels, 14 feet to a side. A vigorous question period followed the speech.

How successful he was, was evidenced by the number of intelligent questions that resulted in the forty minute question period that followed his talk.

The membership drive keeps rolling along with another dozen memberships being finalized this month and more in the offing.

N. Y. Reinforced Plastics Group Hears Panel

Arthur M. Merrill

The Reinforced Plastics Group of the New York Section held its second regular meeting on September 29 at McGinnis' Restaurant, Jamaica. Some 60 members and guests attended the meeting which included a cocktail hour, dinner, and technical session. George Lubin, Bassons Industries Corp. and acting chairman of the Group, presided over the meeting.

Speakers at the technical session were Robert G. Nelb, Naugatuck Chemical Division of United States Rubber Co., who discussed the "Chemistry of Polyester Resins," and Walter Brenner, East Coast Aeronautics, Inc., who spoke on "Plastics for Plastic Tooling." The speakers were introduced by Jerry Bassin, L. Wittman Co. and program chairman for the Group.

Mr. Nelb gave an interesting discussion and review of reinforced polyester plastics, including their resin components, types of glass reinforcement, filler materials, curing, and fabricating methods. He stressed that the reinforced plastics industry is now at a crossroads that will determine its future growth. We need better and faster methods of fabricating the resins we now have, rather than the development of even more resins, Mr. Nelb declared.

Dr. Brenner noted that plastic tools provide simplicity of manufacture, ease of repair and maintenance, weight reductions, greater design freedom, and economic small-production runs. The tools should not be used, however, unless they provide some significant advantage in a specific application. Tools can be made from phenolic and epoxy casting compounds, and from epoxy or polyester laminates with glass reinforcement.

The use of plastic tools is presently limited to applications where temperature does not exceed 200 F. and pressure is not higher than 100 psi. These conditions apply in hand lay-up and bag molding operations. Results to date in press molding operations do not warrant general adoption of plastic tools, Dr. Brenner said, but expected improvements in tooling materials should greatly widen their future range of applications.

SECTION NEWS

Edited by

Stanley Bindmen

Jamison Plastic Corp.
1255 Newbridge Road
North Bellmore, L.I., N.Y.

Largest Turnout Ever at New York Enjoys Symposium on Vacuum Forming

Arthur M. Merrill

One of the largest turn-outs in the history of the New York Section, SPE, was on hand September 15 at the Gotham Hotel to hear a well planned symposium on vacuum forming. Representatives from all phases of the industry were on hand to comment on their particular specialties.

A cocktail hour and dinner preceded the technical meeting at which approximately 150 persons were present. Saul Blitz of Tico Plastics, Inc., acted as moderator for the panel which included artist-designer John Doyel, John Doyel Co.; A. Falkin, Metalmold Forming Corp.; A. Shatz, Liberty Cutting Die Co.; R. L. Butzko, Auto-Vac Co.; L. Contini of the School of Design, Pratt Institute; and S. S. Zimmerman, Vacuum Forming Corp.

Design considerations, according to Mr. Contini, are basically empirical problems which vary with the shape of the product, film thickness, and strength requirement of the finished item. Many of the forms once considered impossible have been achieved by experimentation with design variables. The location of venting holes within the mold is an important item; as a good rule of thumb the speaker specified a spacing of one inch apart and a maximum diameter of 1 32-inch. Weak spots can often be eliminated by changing the pattern of the vent holes rather than by the usual practice of differential heating which can create stresses and strains in the material.

Mold construction materials were covered by Mr. Falkin. Such materials, including plaster, resin, metal castings, wood, and sprayed metal, depend on the specific product to be formed, cost of the material, size of production run to be made, etc. The various advantages and disadvantages of each material were discussed. One of the most important types, sprayed metal molds, made by building up alternate layers of zinc and aluminum (or some other metals) on some base such as plaster, features very good reproduction of detail: adaptability to male or female, single or multiple cavity units; excellent dimensional stability; and the possibility of undercutting as long as the product can be successfully removed from the mold.

Pattern pre-printing on the sheet prior to forming should be investigated at the very onset of planning, according to Doyel. The nature of the plastic, the type of heating, the depth of draw are important factors in this respect and consultation with the printer regarding the type of ink or paint to be employed is recommended. The particular distortion pattern to be used can be found by grid marking the sheet, by using an elastic pattern of true proportions, or by trial and error methods with the sheeted plastic.

Choosing the proper plastic was covered in a talk by Mr. Butzko. Indicating that material costs run from 10-20 times the actual forming cost in these operations, the speaker discussed the reasons for the recent trend to vacuum forming and listed the advantages and disadvantages of the various types of sheeting available. Mr. Butzko also gave some information on the relative cycle time necessary to form these plastics.

Drape and vacuum forming techniques, involving the use of male molds and female molds, respectively, were considered by Mr. Zimmerman. Stating that a much wider range of materials can be used with these methods than with any other fabricating technique, the speaker went on to cite the situations in which one method is more advantageous than the other. For example, raising of the form (instead of lowering the sheet) in drape forming operations permits deeper draws (or cavities) to be obtained.

Cutting or finishing dies were discussed by Mr. Shatz. Press-rule dies, steel rule dies, Clicker Press or high dies, mallet dies, and multiple height dies were all covered with respect to construction, recommended applications, and costs.

The meeting was then opened to questions from the floor, and many interesting problems were discussed.

The door prize of the evening, donated by Augusta Plastics, was won by E. B. Stratton of Auto-Vac Co. Every member of the audience went home with a table favor donated by Tico Plastics, Inc.

The Section's next regular dinner meeting on October 20th will feature a panel discussion on "Plastic Problems from the Buyer's Point of View."

The section added 31 new members during the summer. These members are as follows: L. J. Brettler, industrial engineer, Bassons Industries Corp.; D. E. Broadbent, sales manager, Gilman Bros. Co.; L. M. Calbohn, manager, Fiber Glass Products Div., Bigelow-Sanford Carpet Co.; T. C. Campbell, consulting engineer, Putnam Rolling Ladder Co.; Michael G. Ciganko, technical sales representative, Bakelite Co.; Herman Copeland, development chemist, East Coast Aeronautics; Ralph J. Della Rocca, design engineer, Gibbs & Cox, Inc.; Allan Daniels, president, Baby Worth Co., Inc.; G. C. Elliott, Jr., technical sales, Rohm & Haas Co.; D. M. Fay, sales manager, Reinforced Plastics Div., Bigelow-Sanford Carpet Co.; F. J. Greco, assistant production manager, Lunn Laminates, Inc.; Max Klaidman, sales representative, Auburn Button Works, Inc.; Aaron Landsman, chief engineer, Specialty Projects Div., Bassons Industries Corp.; C. R. Lemonier, chief of Molded Products Div., Fairchild Guided Missiles Div.; Richard Luckow, vice president, sales and development, Victory Mold & Die Co.; Arthur H. Jensen, project engineer, A. Schrader's Son Div., Scovill Mfg. Co.; Richard Mark, engineer, Balsa Ecuador Lumber Corp.; D. S. McNulty, technical service, Celanese Corp. of America; J. M. Medwin, project engineer, Bassons Industries Corp.; Piero Modigliani, president, Modigliani Glass Fibers, Inc.; C. P. Monaco, treasurer and general sales manager, Mastercraft Plastics Co.; Roe Monaco, vice president and factory superintendent, Mastercraft Plastics Co.; Sam Monaco, assistant vice president, Mastercraft Plastics Co.; Maurice A. Nememiah, president, Nechi Protective Coatings, Inc., G. T. Overholt, Jr., sales representative, polyester resins, American Cyanamid Co.; Eugene J. Singer, chemical engineer, East Coast Aeronautics; Vincent Sussman, laboratory director, Applied Engineering Associates; Joseph Tauchin, plastics engineer, Empire Plastics Corp.; H. J. Tracy, mechanical engineer, LeConte Plastics Co. Div. of Bigelow-Sanford Carpet Co.; John P. Valentine, assistant to president director, Russell Reinforced Plastics Corp.; and Sidney D. Yarn, assistant chief engineer, Bassons Industries Corp.

Theory of Finding Right Gate Size for Injection Molding Told at Philadelphia

H. C. Colby, Jr.

The Philadelphia section held their first meeting of the 1954-55 season at the Franklin Institute on October 5th. The usual dinner preceding the meeting was held in the Locomotive Exhibit Room of the Institute instead of the Dairy Dell. The full size locomotive on display made a most impressive back drop for our dinner.

The attendance at both the dinner and the meeting was excellent not only for a first of the year meeting but for any meeting. Section president, Henry Darlington, of A. H. Wirz, Inc., introduced our National Director, Dick Bishop, Foster Granite Company, who brought us up to date on the affairs of our National Organization. Adolph Kissileff, Amplex Manufacturing Company, co-chairman, told us of excellent progress made by his committee for the S.P.E. eleventh technical conference in Atlantic City. It's going to be something you can't afford to miss.

Our speaker of the evening was Mr. David Jones of the technical service department of the Celanese Corporation. His subject was The Theoretical Determination of Restricted Gate Size for Injection Mold Design to Effect Balanced Gating. The premise of Mr. Jone's discussion was a Balanced Gate Value which is equal to the cross sectional area of the gate divided by the product of the square root of the length of the runner to the gate and the length of the gate land:

$$\text{Balanced Gate} = \frac{\text{(Cross Sectional Area of Gate)}}{\text{(Length of Runner to Gate)} \left[\frac{1}{2}\right] \text{(Gate Land)}}$$

To use this formula correctly the four following conditions should be met:

1. A streamline effect should not be present at the gate.
2. All runner arms should be of equal cross sectional area.
3. No conditions should be present in the runner system which would cause high pressure loss such as turned cavity inserts, turned sprue bushings or mismatched runner arms.
4. In multi-gated cavities, to effect balanced gating, the distance from gate to weld line should not be less than the distance from the gate to the end of the part. When this condition exists, packing occurs at the weld.

Mr. Jones pointed out that his formula did not obviate the need for production "know how" but rather took advantage of it to avoid costly trial and error modification of individual gates in multicavity molds after the mold has been set up in a press. Considerable field experience has shown this method of determining gate size for balanced gating to give an accuracy of well over 50%, and in some cases as high as 80%.

The Balanced Gate Value Formula was based on the experimental determination of the effect of the following factors on gating:

1. Cross sectional area of gate — The gate area is the product of the width and depth of the gate. As the area increases the gate value and or the weight of material passing through will increase. In computing width and depth from an area value the relationship of 3 to 1 should be used. On this basis the gate width will always be approximately 3 times the depth. With a depth of .030 inches the width will approach .090 inches.

2. Length of Runner to Gate — The plastic moves only through the hot center core in the runner. The longer the runner the smaller this hot core will become. In the formula the effect of a longer runner is to decrease the weight of material passing through the gate located at the end. The influence of runner length has been determined as not being related to length directly but rather to the square root of the length. With two runners of equal cross sectional area, one being 4 inches long and the second 16 inches long, the material flow at the end will not be as 16 to 4 but rather as 4 to 2. Instead of 4 times as much plastic through the short runner we can expect only twice as much as through the long runner. The distance from sprue to gate is used as runner length.

3. Gate Land — the influence of gate land is such that increased land will exert more resistance to the flow of material and consequently reduce plastic flow.

Following the discussion of the derivation of his formula Mr. Jones did a sample calculation of a ten cavity mold. In this mold all cavities produced equal weight parts and runner diameter as well as the distance between cavities were pre-determined. In making this calculation Mr. Jones introduced the additional concept based on experimental results that there is a constant ratio between the ideal cross sectional area of the gate and the cross sectional area of the runner for any given material.

Mr. Jones has found this ratio varies between .06 and .1 for the styrene resins and cellulosics he has tested to date. Completing his calculations on the basis of the above information and an assigned gate land length which was set on the same for each cavity, Mr. Jones determined the area for each of the ten gates in the mold. Justification for assigning a land length in solving the equation for gate area depends on two factors. First of all, the molder must have had sufficient experience to pick a land length that is reasonable for the material even though this is no guarantee of a balanced gating arrangement. Secondly, returning to Mr. Jones' original formula for balanced gate value it can be seen in the derivation that a definite relationship has been established between land length, gate area, and length of runner; therefore, the assumption of a reasonable land length should allow the calculation of a gate area to give balanced gating. Mr. Jones went on to demonstrate that a constant area could have been used to calculate a variable land length to compensate for different runner lengths.

The last section of the above paragraph contains the meat of the value of Mr. Jones' gate calculation to the molder. You only have to make one guess instead of two and that guess can be pretty far off and still be compensated for by the balanced gate value. Mr. Jones also pointed out that the same calculations could be applied to cavities of unequal size by assigning a linear relationship between gate area and cavity volume.

St. Louis Inaugurates Discussion Period

R. S. McDorman

The St. Louis Section held their first fall meeting on September 21, at the Melbourne Hotel. Their guest speaker was Mr. W. A. Ward, Technical assistant, Plastics Resins Division, American Cyanamid Company.

Mr. Ward gave a very interesting talk on Urea and Melemine and also presented a film to illustrate his topics. The uses of Melamine were shown to range from the popular dinnerware to those for electrical applications. Great emphasis is now being placed on Melamine for electrical applications due to its superior electrical properties. Mr. Ward also told how Melamine and Urea had been improved and reduced in price since their first use.

The St. Louis Section has inaugurated a new program of a question and answer period during the meeting. The program has met with such enthusiasm that it is difficult to limit it to its thirty minutes of alloted time. During the period, someone states a particular question or problem. The others then try to give information from their experience that might be helpful to the solution of the problem. The chapter feels that everyone profits by the exchange of information.

The chapter was glad to have Jim Sharbaugh back after a long illness.

Properties, Uses and Handling of KEL-F Are Described at Newark Section Meeting

D. J. Mullins

Mr. J. A. Jupa of the Chemical Manufacturing Division, The M. W. Kellogg Company, Jersey City, New Jersey unfolded the story of "Kel-F" at the September meeting of the Newark Section.

Mr. Jupa stated that the coming of the Atomic Age placed a severe burden on the existing materials of construction since many highly corrosive and radioactive chemicals had to be contained and processed. The Kellex Corporation, a subsidiary of The M. W. Kellogg Company, designed and built the K-25 Gaseous Diffusion Plants and specified their requirements for a chemically inert, high temperature quality resin as a gasketing material. A group of chemists under the direction of Dr. W. T. Miller of Cornell were assigned the task of tailor making such a product, namely polytrifluorochloroethylene. In this manner, The M. W. Kellogg Company became acquainted with the great potential this material possessed. Shortly after the end of World War II, commercial production of chlorotrifluoroethylene, marketed under the trademark "Kel-F," was initiated by the M. W. Kellogg Company.

Describing the physical properties of "Kel-F," Mr. Jupa stated that "Kel-F" possesses an unusual combination of outstanding physical, electrical, mechanical and chemical properties. Prolonged exposure to concentrated nitric acid, sulfuric acid and hydrofluoric acid have no effect on "Kel-F." Since "Kel-F" is insoluble in the true sense of the word there is no significant effect from any other commonly used aromatic and aliphatic solvents. "Kel-F" has a zero moisture absorption and permeability. Films in thicknesses of 3 mils or greater have shown 0.00% moisture permeability in the General Food tests for periods extending over one month.

Few materials possess such a wide operating temperature range, namely 710 F. "Kel-F" may be used from temperatures as low as minus 320 F. to a high of plus 390 F. The elastic modulus of this material varies so little with temperature that thinner sections of "Kel-F" can be fixed in liquid nitrogen without shattering. "Kel-F" is inherently a rigid rather than an elastomeric plastic possessing high impact strength and outstanding resistance to thermal shock. "Kel-F" is one of the four best electrical plastic materials. It possesses a relatively low dielectric constant — approximately 2.3 to 2.6, high volume resistivity — 1.2×10^{18} ohms per centimeter, and high insulation resistance. Arc resistance is greater than 360 seconds and does not show evidence of carbonization in the electrode area.

No significant difference has been observed in the appearance of the molecular weight after exposure to Florida sunlight for a thousand hours. Outdoor aging at Jersey City for several years has developed no apparent changes in the plastic material.

"Kel-F" can be adapted to injection molding, extrusion, compression and transfer methods with minor modification in equipment. Subsequent machine operations such as drilling, punching, turning, sanding, buffing and polishing can be handled by conventional methods used on other thermoplastic materials.

Mr. Jupa rounded out his speech by describing in detail proper methods for using "Kel-F" in injection molding, extrusion, compression and transfer molding. He also described "Kel-F" dispersions, oils, greases and waxes.

Newark President, J. L. Bonanno, announced that the Newark and New York Sections of the S.P.E. and the Metropolitan Section of the A.S.M.E. have collaborated to sponsor a symposium on plastics. These seminars will be held in the Engineering Societies Building at 29 West 39th Street, New York City on Monday Evening, September 20th, Monday Evening, September 27th, and will conclude on Monday evening, October 4th. President Bonanno sincerely hopes that S.P.E. members avail themselves of this excellent educational activity and hopes that this symposium will be a forerunner of greater activity in promoting the entry of young talent into the fast growing plastics industry.

Table favors for the September Newark Section meeting were donated by The Mack Molding Company, Wayne, New Jersey. Door prizes were donated by The Dow Chemical Company and by Van Amo of M & W Co., Rahway, New Jersey.

Toledo Meeting Topic Molding of Ethylene

R. E. Dunham

On April 28, 1954, Mr. Harold Holz of the Bakelite Company gave the Toledo Section an inspiring talk on the "Molding of Polyethylene" after a fine dinner at the Tivoli. Mr. Holz reviewed the basic fundamentals concerning polyethylene and exhibited many items made from polyethylene. A spirited discussion completed the meeting.

Following dinner at Harrison's Ranch House, Mr. Don Hoffman, National Vice-President of SPE and Manager of Evans-Winter-Hobb, Inc. discussed "Jet Molding of Thermosetting Plastics." Mr. Hoffman pointed out the similarities between jet molding and injection molding and described the equipment specially designed by his firm to mold thermosetting materials by the jet process. The talk was well received by the Toledo Section.

A Golf Party was held at the Chippewa Golf Club on July 2 to complete the spring program. A good time was enjoyed by those attending.

Southern Section Talk On Injection Molding

C. Veazey LeCraw

The Southern Section was fortunate to have one of its members, Mr. Maurice J. Bernard of N.A.C. Products, as its speaker for the August Meeting. Mr. Bernard spoke to the group on "Injection Molding."

Mr. Bernard has had a great deal of experience in the field of injection molding and was able to give the group many pointers on the proper technique of designing both the plastic part and the mold from which it will be made. He emphasized the importance of spending enough money on the original mold design and fabrication in order that money may be saved in the long run due to decreased costs for redesign and rework.

Examples of bad design in plastic toys were shown to the group by Mr. Bernard, and it was also shown how these toys would have been real "money makers" had they been designed properly.

For our September meeting, Mr. Charles Neal will conduct a guided tour of Fulton Bag and Cotton Mills where the group will view the manufacture of polyvinyl chloride and polyethylene bags and other packaging materials.

On October 11, the group is planning to charter a plane to Columbia, S. C., where the regular monthly meeting will be held. We have several members of the Southern Section who commute from Columbia to Atlanta for our meetings, so it was decided to hold one of our meetings there. The Section will be the guests of Southern Plastics Co. and Colonial Hites Co., both of Columbia.

The Southern Section is growing in number and in enthusiasm with each meeting.

The Section was officially chartered in February of this year and as of August shows 57 members on its roles. This number is larger already than nine of the twenty-nine sections of SPE. It is believed that this Section, which is the first SPE section in the Southeast, will do much to promote the use and understanding of plastics in this area.

Methods Improvement Can Reduce Costs, Improve Efficiency and Quality . . . Buffalo

R. W. Miller

Members and guests of the Buffalo Section of the Society of Plastics Engineers, met at the Park Lane in Buffalo September 17. Those present were enlightened by a talk on the very important subject of Methods Improvements. This subject was well presented by Mr. William V. Bergren, Supervisor of Time and Motion Study of The Carborundum Company, Niagara Falls, N. Y.

Mr. Bergren pointed out that Methods Improvement is the act of finding the one best way of preforming a job with the most economical use of manpower and equipment. The following program as described by the speaker is a broad description of the application by trained individuals of certain techniques and principals. The program is the text of a course of instruction given to management type people at The Carborundum Company in an attempt to effectively reduce costs. The program was quite successful as pointed out by Mr. Bergren and is going to be broadened if possible to include as many individuals as possible.

Object

The object of a concentrated program of Methods Improvement is to reduce costs, improve quality, improve customer service, and also to improve plant efficiency.

Approach

1. **Selection of the operation to be improved**
   This is dependent upon whether it is a bottleneck operation, has ineffective use of manpower or provides a product with poor quality.
2. **Break down the operation**
   This is the act of defining in detail what actually is done in the performance of the operation.
3. **Analyze the operation**
   Mr. Bergren pointed out this is best done by asking the what, why, when, where, who, and how questions. This determines the essentiality of each step in the work procedure. Here we determine whether each step of the process makes a specific contribution in getting the work accomplished.
4. **Develop the New Method**
   This is the act of organizing the operation into its most efficient method. We can do this by eliminating, combining, rearranging, or simplifying the operation.
5. **Install the New Method**
   Placing the new method into operation is self explanatory.

Based on the above approach a program can be organized in any plant that will reward the participants with savings of up to 10% or better.

Mr. Bergren pointed out that one large obstacle is to convince those individuals who claim that "we've" been doing it this way for 25 years and that's good enough for us." We must use the open mind approach and try to encourage people to see the good in new ideas and not the obstacles. Too often, he pointed out, a foreman looks upon a suggestion of method improvement as a criticism of his own efforts. Past investigation of a method should not preclude its being reinvestigated. New tools, etc. could very well provide a solution. He stated that an investigation of a repetitive job is one that is capable of paying back the biggest returns. He emphasized that methods improvement is not a form of speedup. It merely allows a man to produce more with the same effort.

Mr. Bergren closed his talk by listing the following rules of the road:

1. Consider all the facts.
2. Break each problem down.
3. Figure out a better way.
4. Check the results.
5. Control your personal feelings.
6. Be a doubting Thomas.

Ladies Night

The Buffalo Section held its annual Ladies Night June 18, 1954 at the Park Lane Restaurant. Approximately 120 members, wives and guests attended. The program consisted of a film titled "Kitcheneering," courtesy of the Monsanto Chemical Co. Mr. E. V. Hellyar of Monsanto amplified the above mentioned film and also spoke on "Plastics for Everyday Living."

The film "Kitcheneering" depicted what the average housewife could buy with $15.00 to dress up her kitchen. These articles, all fabricated from plastics, were such items as curtains, cannisters, etc. The results were remarkable and the comments expressed by the ladies indicated that the movie was well received.

Mr. Hellyar's speech traced the development of the plastics industry, emphasizing its growth. He stated that the plastics industry increases about 10% per year compared to 3% per year for general industry.

The following types of plastics were discussed, along with their uses listed.

Styrenes—Toys, Refrigerator Parts, Phonograph Records.

Vinyl Chloride — Garden Hose, Sheeting.

Phenolics — Utility Handles, Telephones, Washing Machine Agitators.

Melamines—Dishware.

Polyethylene—Film, Pipe, Bottles.

Cellulose—Eye Glass Frames—Mr. Hellyar stated cellulose nitrate is still the only type of plastic that can be used for eye glass frames.

Acrylics—Car Tops, Display Cases.

Nylon—Stockings.

Mr. Hellyar compared the plastics industry to a giant iceberg. He stated that continued Research and Development surfaces more of the iceberg. As yet no one knows how large the iceberg is. By 1960 he stated each family will consume 150 pounds of plastics as compared to 83 pounds this year.

In closing he listed the following trends in the plastics industry:

(1) Trend toward better physical properties.
(2) Trend toward better design and fabrication.
(3) Trend towards the "do it yourself theme," i.e., plastic tile in kitchen and bathroom, use of plastic film for curtains, upholstery, draperies, etc.

At this point the meeting was turned over to Hi Nathan and Art Enge who distributed gifts and awarded prizes to the ladies. Every lady present went home richer in the knowledge of plastics and also with an assortment of gifts and prizes.

Eastern New England Program for the Year

Walter W. Peacock, Jr.

The Eastern New England Section of SPE, and the Boston-Providence Chapter of SPI hold their meetings jointly. In general, we hold them on the third Thursday of each month (exception, December 15 meeting). The following is a list of meeting dates and subjects.

Sponsor	Date	Subject
SPI	Sept. 16	Management topic
SPE	Oct. 21	Injection Molding
SPI	Nov. 18	Merchandising
SPE	Dec. 15	Ladies Night Christmas Party
SPI	Feb. 17	Management topic
SPE	Mar. 17	Vinyls
SPI	Apr. 21	Technical Symposium
SPE	May 19	Natick Quartermaster Corps

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Canadian and U. S. Molding Practices Discussed at Western New England

George Snyder

A touch of international economics set the theme for the fall kick-off meeting of the Western New England Section, held September 8 in the Terrace Dining Room at Bradley Field Terminal, Windsor Locks, Conn. The eighty members in attendance heard Mr. Wilfred Lynch of Moxness Tool Works, Racine, Wisc., and past president of the Quebec Section, discuss Canadian and American molding practice.

Allowing that it was extremely difficult to pick out "typical" Canadian or American molding techniques, Mr. Lynch explained that many of the differences that do exist in operating procedure are the result of basic differences in commerce and economics of the two countries. Although most of the direct political ties with Britain have been dissolved through the years, he said, Canada is still a member of the British Commonwealth in world trade circles and much of her business policy is based on certain international considerations.

An example he cited is the low tariff situation in Canada that often works somewhat of a hardship on Canadian molders in that it intensifies outside competition and makes the margin of profitable operation much narrower than it might otherwise be. The result is that the Canadian molder is very astute in matters pertaining to mold costs and operating expenses, Mr. Lynch said, and the element of cost is often the dominant factor in production and design decisions to a much greater degree.

With business volume also somewhat lower generally, short runs are common, presses are built rugged and simple, and a high rate of efficiency has been achieved with the simpler type of hand mold. In the dishware field especially, family or multi-cavity molds are very prevalent, he said, and a great deal more mold trading and rental takes place in Canada than in the United States. The latter practice Mr. Lynch again attributed to the need for production economy. He intimated that cost-cutting is such a primary consideration throughout the entire operation that product design sometimes suffers because it is one of the areas where costs can be reduced most easily. For this reason, he said, Canadian design in certain fields lags behind American, with much copying

Wilfred Lynch

of American design changes after market tests have established the likely trends.

Another aspect of the low-tariff situation in Canada, Mr. Lynch pointed out, is that it is often more economical to import tools and dies from Europe than to build them in Canadian shops. He observed that even with the higher protective tariff in the States, that stateside molders also resort to importing the lower-cost tools when the time element is not too critical.

Other contrasts and comparisons Mr. Lynch mentioned were in the fields of quality and over-all production standards. He expressed the opinion that quality in molding has come to depend heavily on the degree of automation that exists in the equipment used. Since automation varies considerably in the Dominion, he said, product quality is still quite erratic but that the trend is strongly toward automation.

Concluding, Mr. Lynch felt that Canadian molders give inadequate attention to finishing processes which he said were generally weak compared to American standards.

Mr. Lynch, until recently associated with Boonton Plastics Co., (N.J.), is an expert on melamine and urea dishware molding technique and has worked primarily with high-temperature thermosetting materials during his career in the industry. He is a 1st Award winner in Canadian plastics competition for best mold design (1952), and served on the Canadian government specifications board panel on plastics tableware (1951-52).

Milwaukee Enjoys Home-Town Product

Marvin C. Stowe

The Milwaukee section of the Society of Plastic Engineers began the year's meeting with an informal get-together at The Miller Brewing Company of Milwaukee, Wisconsin. The Miller Brewing Company furnished free drinks and a splendid dinner to 80 Milwaukee S.P.E. members and guests. Included in our generous host's hospitality was an interesting tour of the Brewery. This was an opportunity for us to see how another great Milwaukee product is produced.

After the dinner our President, Mr. George Stein, thanked Mr. Fred Miller, President of the Miller Brewing Company and his staff at the Miller Inn for their fine hospitality. He then briefed us on a few of the main attractions for the coming year. From the looks of it the Milwaukee section will again enjoy another great year with many interesting and educational speeches and tours.

Frank H. Bailey

Frank Harvey Bailey, Box 47, Route 3, Thiensville, Wisconsin, died Thursday, August 26, two days after suffering a paralytic attack as a result of a brain tumor. He was 41.

Mr. Bailey was Chief of Development Research and Production, Consolite Division, Continental Can Company. He was graduated from Lehigh University in 1941 and was for 7 years a member of the Research Staff of the New Castle, Pa., Laboratories of the American Cyanamid Company before joining Continental Can.

He was a National Board Member of SPE and Secretary of the Milwaukee Chapter. He was also a member of the American Chemical Society, the American Institute of Chemical Engineers and the Society of the Plastics Industry.

Mr. Bailey is survived by his widow; two daughters, Diana Sue, 4, and Brinda Sue, 2; his parents, Mr. and Mrs. James Bailey, West Hartford, Connecticut; and a sister, Mrs. Gerald Breese, Princeton, N.J.

Mr. Bailey's father was the 1947 Hyatt Award Medalist for 1952.

Fibertuff Introduced To R. I. and S. E. Mass.

Stephen Kalarian

Thirty-eight members of the Rhode Island and Southeastern Massachusetts Section of SPE sat down to a roast beef dinner at the Wayland Manor Hotel in Providence, R. I. last September 23rd.

The dinner was followed by a short business meeting which revealed that treasurer Allen Barker increased the kitty by several hundred dollars since he took office last year. Vote on a Christmas party was postponed until the next meeting.

First guest speaker for the evening was Mr. Rod Garry of William Brand and Company. He expounded the topic "Insulated Copper Wire Mill Product Trade Association." He cited the grave need for such an organization for the following reasons:

1. To foster fair trade in this group.
2. To prevent and discourage unfair methods of operations such as false advertising.
3. To create and maintain relations between manufacturers in order to cope with common problems.
4. To establish a clearing house for statistical data which would be available to all members.

Mr. Garry emphasized strongly that such a trade association is not established to fix prices or to control territories. These latter functions are in direct opposition to the true nature of a trade association. Mr. Garry closed his talk with the hope that a trade association will be formed by the manufacturers of insulated copper wire.

Second guest speaker was George Kassling from the Koppers Company. He did a nice job of introducing "FIBERTUFF" to us through his eloquence and photographic slides. Notable feature of this high impact, filled polystyrene is its suitability for injection molding. "Fibertuff" material is supplied in pellet form $\frac{1}{8}$ dia. x $\frac{1}{2}$ long. Each pellet contains approximately 12000 individual strands of glass filaments which are held together by a heat resistant type of polystyrene.

The above material has numerous applications as housings, battery cases, impellor fans and so on. Price ranges approximately from $.50 a lb. to $1.00 a lb. depending upon quantity.

The R. I. Section is happy to announce the following additions to its membership:

William Augat, W & A Tool Co., Attleboro, Mass.; William Augat, Jr., W & A Tool Co., Attleboro, Mass.; Walter Cole, Greene Plastics, Wakefield, R. I.; George Gillian, Aerovox Corp., New Bedford, Mass.; Miss Flise Harmon, Aerovox Corp., New Bedford, Mass.; Anthony Rego, Industrial Plastics, Whiteman, Mass.

Prior to departure a beautiful Sheaffer pen and stand was won by Mr. Hugo Anderson of Hugold Anderson, Inc. Prize was donated by Mr. Ralph Symons of Ralph B. Symons Associates, Inc. of Tiverton, R. I.

Decoration of Plastics Is Described for Cleveland-Akron Section

R. M. Hershey

The Cleveland-Akron Section inaugurated the 1954-1955 season with a dinner meeting on September 20 at The Spanish Tavern, with approximately 70 members and guests in attendance.

Two interesting talks on "The Decoration of Plastics," and "The Masking and Spraying of Decorated Plastics" were given by Dr. Donald R. Swan, Director of Research of The Forbes Finishes Div., Pittsburgh Plate Glass Company, and by Milton T. Schimmel of The Conforming Matrix Corporation, respectively.

Dr. Swan pointed out that there were three major reasons for applying a finish to rubber and plastic items. The finish can decorate, protect, or up-grade an article. Numerous specific applications in the automotive and toy field were discussed and samples of the applications were shown. Dr. Swan emphasized that nearly every application was unique and required individual consideration.

The use of masks to cut finish spraying costs was discussed by Mr. Schimmel. The dimensional stability of the plastic material was cited as the most important factor governing use of spray masks for plastic moldings.

Any change in molding conditions or handling conditions may affect the dimensions of the molded parts and change the fit of the molded parts and change the fit of the mask, thus contributing to poor results.

Three basic types of masks were exhibited and described. The lip mask has a lip of metal extending down the sidewalls of a depression which is to be painted. When a depressed design is to be kept clean a plug mask can be used. The cut-out mask for plane surfaces is least dependent upon the dimensional properties of the moldings. Most of these masks are made by the electroforming process.

Mr. Schimmel stressed the importance of using correct spray techniques in order to obtain optimum results with spray masks. At the conclusion of his talk, Mr. Schimmel passed out copies of several brochures which described spray masks and spray painting techniques.

It was announced at the meeting that the Third Annual Joint Cleveland-Akron SPE-Akron Rubber Group meeting will be held on Friday, October 22. A well qualified panel will discuss "Plastics and Rubber Foams."

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Northwest Pennsylvania Reports

Paul C. Roche

No initial fall news report should be considered without happy mention of an SPE Section summer outing. This season rates customary compliment in this regard, with special honors to Lloyd Moore, Bill Phillips, Don Leet and other busy committee members. With at least 125 attending, the event was typically successful not only from the standpoint of checking the capacity of the digestive system and the outdoor sports department, but also with regard to establishing unprecedented success in the redistribution of the currency.

A personal note that we are very happy to cover pertains to John Reib of Shaw Industries, Inc. John's card now reads Vice President of that Company; also he has removed his moustache. My only conclusion with regard to the latter is that it has served its purpose by way of convincing the Corporation that he is now a man.

I been wanting to extend a special credit mention to a rather new Erie Company which many of us oldsters in the section hold in very high regard. I refer to Finish Engineering Company, whom we consider as basically producers of painting masks and associated fixtures. It did not take long for the local molders to commence stretching the territory of the company to cover such things as cement application fixtures and sidelines of that category, which were successfully handled without hesitation. However, it would appear that one customer recently threw a curve at them by approaching them for salvage fixtures to reclaim a couple of truckloads of rejected assemblies with irregular cemented seal. I understand that Finish Engineering Company took this project in their stride, developing heat-sealing procedure and fixtures in considerably less than one week's time at a total cost of a few percent of the merchandise value involved.

Nosco Plastics Incorporated has recently ordered pre-plasticizer attachments for its larger press equipment. This program was released after a thorough investigation of the advantages involved. The basis of going into this program is not so much to invade the 100+ ounce category normally associated with pre-plasticizer operation, but to enhance the efficiency of production in the 32-60 ounce range.

Fiberglass-Polyester as an Engineering Material is Demonstrated at Miami Valley

Martin H. Kasch

The first fall meeting was held September 9, 1954 at the Wishing Well, Centerville, Ohio. Mr. Byron Nelson of the Plastics Laboratory of the National Cash Register Company and a member of the local section was the speaker. His subject was "Fiberglass Polyester as an Engineering Material."

His talk was illustrated by the use of enlarged photos, charts, samples, and demonstrations. Comparisons were shown on size of presses required for molding low pressure forming of polyester glass material as against the size required for molding phenolics, ureas, and melamines.

For deep draws, preforms similar to final shape are made, placed in mold, resin added and molded at pressures of about (200) pounds per sq. in. The phenolics, melamines, and ureas require (2000)-(6000) pounds per sq. in. pressure.

Comparisons of tooling costs were shown for fiberglass polyester material and cabinet steel showing a much lower cost for the fiberglass polyester material tooling.

Also, it was pointed out the piece cost of fiberglass polyester material parts were lower than cabinet metal in examples shown.

The physical properties of fiberglass—polyester materials were compared with cabinet steel, cast aluminum and sheet aluminum. It was pointed out that fiberglass is stronger than steel on a weight basis, but not on volume. The fiberglass material has a wide range of tensile strength but not as high as sheet metal etc.

Demonstrations were made to show rigidity, limit of elasticity and impact. Charts were used to show modulus of elasticity, tensile strength and specific gravity of fiberglass polyester and metals. The fiberglass having a much lower specific gravity indicates a lighter weight product.

Photos were shown of a number of existing large size parts presently being moulded from fiberglass polyester material.

In conclusion Mr. Nelson stated that fiberglass polyester material truly had a place of importance in the industrial field for many reasons, some as follows:

1. Reduction of weight
2. Reduction of noise
3. By proper design parts can be made equivalent to steel in functional properties and in some cases superior
4. Lower tool costs
5. Lower piece price
6. Increased speed of placement of new models in field
7. Elimination of corrosion

Thirty-eight were in attendance at the dinner meeting including guests. Welcomed to the meeting were:

B. B. Curl — Allen Tool Co., Springfield, Ohio
A. T. Larned, Jr. — Owens-Corning Glass Co.
Jack Helgesen — Baxter Co., Cincinnati, Ohio
Frank M. Maess — N. C. R. Company, Dayton, Ohio
Thos. E. Colvin — J. E. Barron Assoc., Cincinnati, Ohio
Joe Rasche — J. E. Barron Assoc., Cincinnati, Ohio
Robert Lanzit — Rogers Corporation
Harry Kreuzman — Crosley Corporation, Cincinnati, Ohio
Hanford Sturey — G. E. Aircraft Gas Turbine, Cincinnati, Ohio
Wm. Bundy — G. E. Aircraft Gas Turbine, Cincinnati, Ohio

We were indeed sorry to hear of the death of Mr. John R. White (better known as Bob) a member and director of Miami Valley Section. He was treasurer of our section last year. Bob went on vacation to his home town, Columbia, South Carolina, on August 2nd, became ill on Sunday August 8th, and died on August 12. He was buried in Columbia, S. C. Bob was born in December, 1923, attended University of South Carolina, served in World War II, joined the Buckeye Molding Company in 1[illegible] and moved with the Company in 19[illegible] to Miamisburg, Ohio. He was Chief Engineer at Buckeye. He leaves his wife Mildred and two children, Constance 3½ years and John, Jr. 1 years.

A section Directors meeting will be held September 24th at the home of Mr. Joe Merke. The next meeting will be on October 7th. The speaker will be Mr. Stanford Zimmerman of Vacuum Forming Corporation at Port Washington, New York. His subject "Vacuum Forming," will be illustrated with samples and slides.

Central Ohio Section Reports New Officers

The Central Ohio Section has elected the following officers for the 1954-55 year:

President, A. [illegible] Young, Yardley Plastics; **President-Elect,** R. R. Dyer, Westinghouse Electric; **Secretary,** W. L. Croll, Hydraulic Press Mfg.; **Treasurer,** J. A. Charlton, Plastex Pipe.

Levy Leaves Empire

Empire Brushes, Inc., have accepted the resignation of Mr. Kalman Levy as Purchasing Director, as of September 7th, 1954. His severance of employment was accepted with deepest regret. Mr. Frank De Rose, Purchasing Agent, will now assume complete charge of the Purchasing Department.

Plastic Auto Body . . .

(continued from page 31)

epoxy laminate. The plug is placed under- bag during vacuum bag molding.

For best operation, the male plug is made of a rigid It requires care and preparation for lamination a mold. Preferably, its surface should be as glossy as practical.

When using a male plug, both faces of the laminate are finished. Thickness control is greatly improved, resulting in higher quality laminates at a small increase in tooling costs. Of equal importance is the substantial increase in laminating speed acquired by improved resin flow. Resin-rich areas are almost eliminated. Articles made by this approach require only trimming.

The application of heat greatly increase the rate of cure. This has been accomplished by placing heating mats over the lay-up, imbedding resistance wire within the mold and in a few cases, imbedding resistance wire within the male plug.

MATCHED PLASTIC DIES have also been used. In this case special clamping devices such as C-clamps, carpenter clamps and hydraulic jacks have been used to gain sufficient closing pressure. This technique is usually confined to small molds, because it is difficult to obtain inexpensively the necessary closing pressures for large molds. Using matched plastic molds gives high quality laminates with excellent control of thickness. Laminates, however, must be trimmed.

Even at best, molding on plastic tools by these methods does not give the high rate of production required to be competitive with metal stamping. One piece every 30 to 60 minutes is very high production. This is especially true of large moldings. To be fully competitive, the rate of production must be stepped up to one piece every 10 to 60 seconds. Low-cost tooling allows us to use duplicate tooling. But this in itself cannot sufficiently increase production rates.

When we turn to matched metal molding, production rates can be substantially increased. Furthermore very little labor is needed to complete the piece produced by this technique. Cleaning the flash and at times a finishing operation are all that is needed. Moldings have been made in thirty seconds to ten minutes. The average is about three minutes.

Pieces produced by matched metal moldings have been difficult to finish to the high gloss for which the automotive industry is noted. The fiber pattern persists in showing through the paint layer, especially under high humidity conditions. Fiber pattern has been eliminated by the Owens-Corning Corporation through the development of a new type of surfacing mat. This mat is made of single filaments which are quite long, giving reinforcement to this surface layer. Folding and creasing of the mat does not cause trouble.

Matched metal molding requires a much higher capital investment, not only for the molds, but for the large presses which are required.

When mat is used, considerable tailoring is necessary. This is especially true of moldings made on temporary tooling. Preforming the glass fibers to shape has advanced matched metal molding a great deal. It is expected that preforming of glass fibers will also greatly contribute to molding by the bag techniques. Full use of this technique has not been seen to date.

Essentially, the autobodies are cemented together. These steps have been greatly speeded up through the use of assembly fixtures made of reinforced plastic laminates. Experience has shown that they should be made of heavy laminates to prevent distortion through use. Checking fixtures and drill baskets have also been made of laminates. These inexpensive tools have greatly contributed to increased production rates.

Plastic Material Problems . . .

(continued from page 21)

ly when it must be supported by structural members such as roof trusses. An important requirement in this service is compatibility of conduit with the cables it may enclose. At operating temperatures volatiles from either item may alter known characteristics. A test we use to determine this is shown in figure 12.

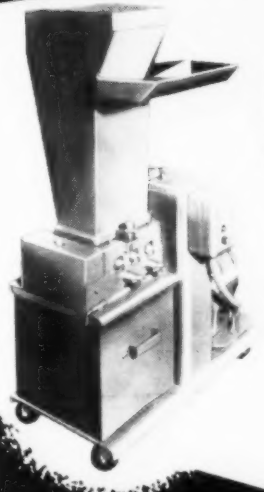
A length of cable, pvc-sheathed in this case, is enclosed by and contacts a shorter length of plastic conduit. The end closures hold in the volatiles. The whole is then placed in an oven at 100° or 140° F, depending on the service, for periods ranging from 30 to 90 days. At present we rely on Durometer tests of the cable and visual examination of the conduit to detect incompatibility. In one test, after 21 days at 100° F, pvc softened to the extent of a 10-point drop in Durometer, but appeared unchanged otherwise.

Many other tests are run, but these are involved in the last service to be discussed which, because we think it is unusual, will be treated in some detail.

(please turn to page 46)

ASTM Bulletin, Dec. 1951.—W. C. Ellis and J. D. Cummings.

Economy-Minded Molders Use the NEW IMS



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Plastic Material Problems . . .

(continued from page 45)

HIGH-VOLTAGE PLASTIC PIPE LINE

The commonest method of transmitting electrical power at high voltages is by the well-known overhead line and steel towers. An alternative method is to adequately insulate the conductors, sheath them in lead and put them in an envelope, such as protected steal pipe placed underground. A three-conductor 120,000 volt line can be housed in a six-inch diameter pipe.

The steel pipe employed comes in 40-foot lengths, factory-coated to about ½ inch thick with combinations of bituminous materials and reinforcing membranes. This protection stops six inches from the ends to permit joining the length by welding. The resulting 12-inch bare section is covered by hand with bituminous coatings. While it is possible to factory-coat the pipe faultlessly, when the finished line is lowered into the earth and tested electrically, it inevitably has misses or "holidays". This necessitates additional protection by sacrificial magnesium anodes to protect the costly installation and ensure good service life. As can be seen, there is an appreciable difference between the invoice price of the pipe per foot and the overall cost per foot of the installation.

There are many other problems associated with the use of steel pipe and because of these we were asked to explore the possibility of replacing the steel pipe with plastic pipe. We were given these requirements by the Transmission Engineering group. How would you like to meet them?

1. Inside diameter—6 inches (possibly 8 and 12).
2. Lengths—not less than 20 feet.
3. Long bends—on a 20-foot radius.
4. The space between cables and the pipe is filled with nitrogen containing 1% Freon for leak detection purposes, the gas being at 200 psi continuously. An alternative pressure medium may be insulating oil at the same pressure.
5. Installed test pressure—300 psi for 24 hours.
6. Cable sheath temperature at point of contact with pipe is 60°C (140°F).
7. Cable weighs 22 pounds per foot, but owing to limited area of contact the pressure on the pipe is appreciable.
8. Soil conditions, pH ranges from 5 to 9; [illegible] rubbish fill.
9. Required factor of safety in pressure is 4.
10. Minimum life to be 40 years.
11. Pipe must be competitively priced with the steel now used.
12. Pipe will run under roadways and will therefore be subjected to vibration from heavy traffic.

Obviously, most thermoplastics are out of the question. This seems made for glass-fiber-reinforced polyester or epoxy. We were determined to limit our search to some manufacturer already in production and are now evaluating a glass-fiber-reinforced polyester pipe for the application. When we get one that, from the results of chemical and physical tests in the Laboratory, shows promise of being able to meet the requirements, we plan to put in a small-scale installation say, 300 feet long, containing appropriate cables and subject it to service conditions to see field behavior.

What are we particularly concerned about?

1. Behavior under continuous high pressure, particularly when the pipe has absorbed all the moisture it can from the soil.
2. The effect of thermal cycling. Since the cables are for power they will heat up and cool with periodical load cycles and the plastic pipe will expand and contract in cycles. Will there be thermal fatigue?
3. What is the effect of immersion in alkaline soils? Polyesters are adversely affected by such conditions. Preliminary tests using distilled water, water buffered at pH 8 and water buffered at pH 9 as media for immersion gave somewhat similar absorption values, 0.5% for three days and 1.5% after 35 days. The alkaline waters were reduced in alkalinity showing chemical reaction.
4. Effect of moisture absorption by the pipe on the dielectric breakdown of oil when used as a pressure medium; compatibility of pipe with oil and vice versa.

Of course, there are many other chemical and physical tests, but all are being done with a view to securing a plastic pipe that gives the most promise of a 40-year minimum life, even though no one but an optimistic salesman would "stick his neck out" and say that it will.

CLASSIFIED ADS

Situations Open

Phenolic Resin Chemist . . . Needed for product development in expanding organization. Four years or more experience in phenolic resins and or molding compounds required. Location Philadelphia. Give full particulars including current salary or expectations.

The Borden Company, Chemical Division, 5000 Summerdale Avenue, Philadelphia 24, Pennsylvania.

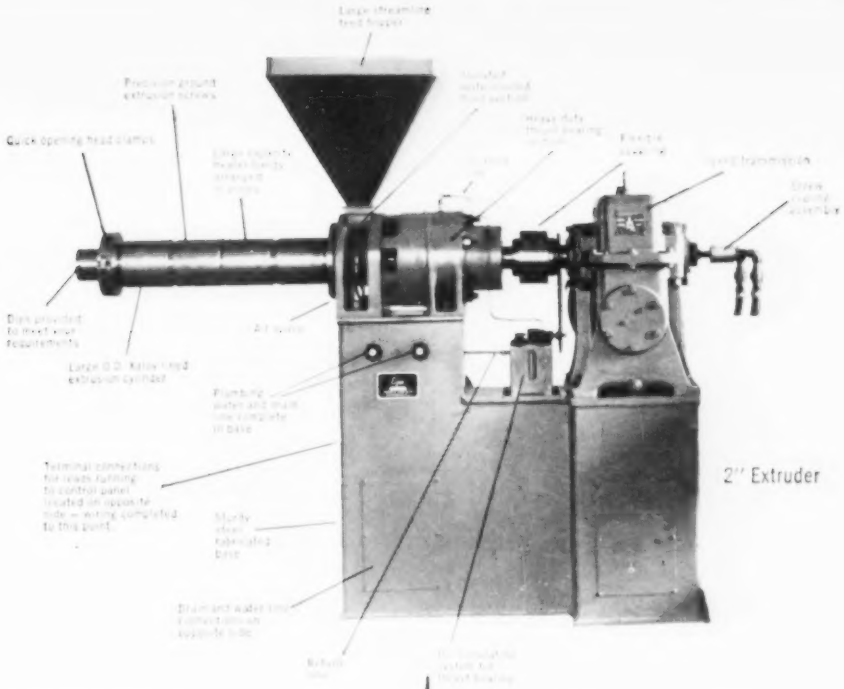
Situations Wanted

AVAILABLE: Polyethylene experience. Graduate engineer with unusual record of accomplishments in polyethylene film extrusion and processing. Over ten years production, development, and supervisory experience in plastics industry. Family. Will relocate for more responsible position. Reply Box 1154, SPE Journal, 34 E. Putnam Ave., Greenwich, Conn.

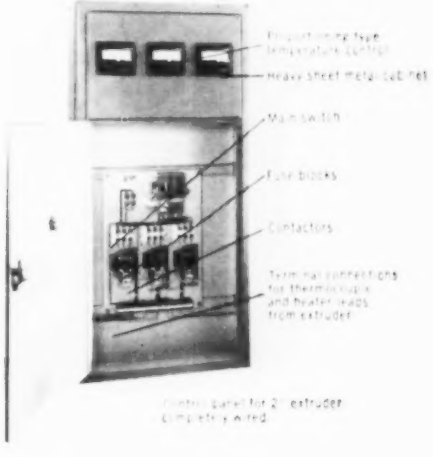
Graduate chemical engineer with six years development experience with vinyls, casting compounds and coatings. Development of applications for various materials; Development of evaluation and test methods; Supervisory experience seeks opportunity in sales engineering or engineering development. Willing to relocate. Box 2554, SPE Journal, 34 E. Putnam Ave., Greenwich, Conn.

Engineer, Product, Plastics—17 years experience in plastic molding, both compression and injection, including molded parts design, mold design, supervising initial production, trouble-shooting for production, cost reduction, and sales quotation. Two years Harvard, 45, married, free to travel, will relocate for suitable opportunity. Box 2454, SPE Journal, 34 East Putnam Avenue, Greenwich, Connecticut.

Egan plastic extruder



2" Extruder



Control panel for 2" extruder completely wired

Compare specifications of any standard Egan Extruder, size for size, with any other extruder.

Standard Sizes (Screw Dia.)—inches	2	2½	3½	4½	6	8
Effective Screw Length—inches	32	40	56	72	96	128
No. Cylinder Sections	1	1	1	1	2	2
Zones of Heating on Cylinder	2	2	3	4	4	4
Maximum Heating Load, KW	12	18	30	48	96	160
Thrust Bearing Capacity, 1000 lbs. @ 50 rpm.	60.5	60.5	119.5	208	288	420
Type Speed Transmission	Worm gear.	Worm gear.	Herr' bone	Herr' bone	Herr' bone	Herr' bone
Usual Motor Size, H. P.	7½-10	10-15	20-30	40-50	50-75	75-150
Approx. Extrusion Capacity lb./hr.	20-50	40-90	75-200	150-450	250-650	450-1200
Approx. Floor Dimensions—inches	40x98	48x112	60x120	84x132	96x156	104x192
Approx. Weight—lbs. (less Drive)	3200	3600	4800	6600	9600	12500

**Extruders are modified to meet requirements for a particular process*

Plastic Material Problems . . .

(continued from page 45)

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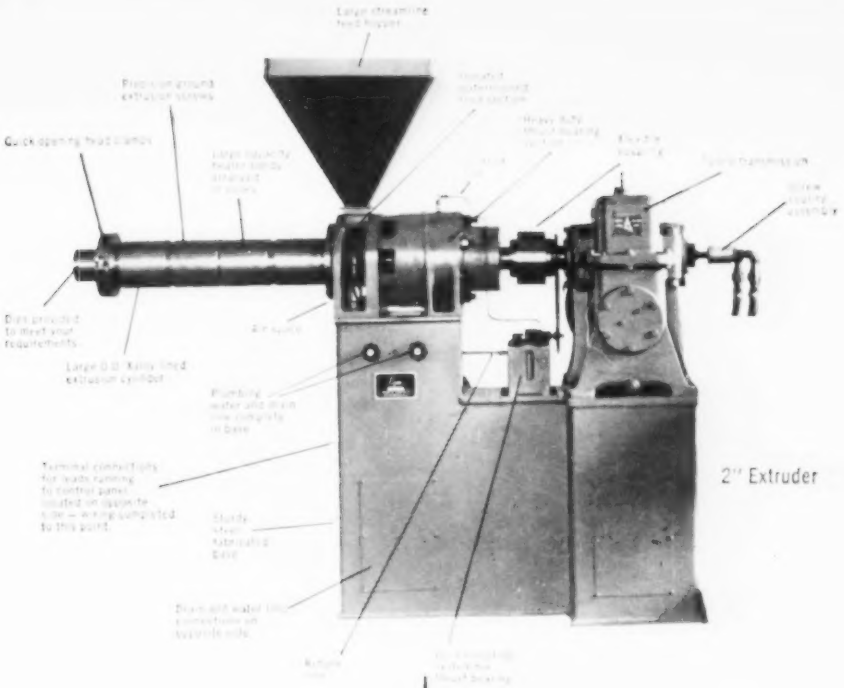
Egan plastic extruder



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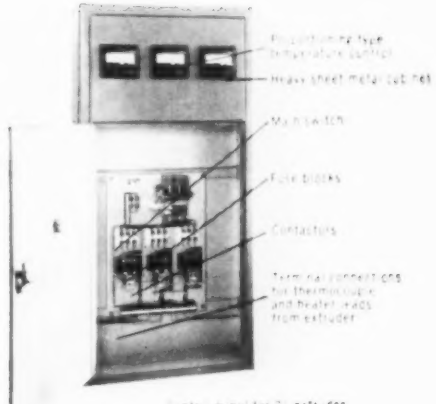

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Standard Sizes (Screw Dia.)—inches	2	2½	3½	4½	6	8
Effective Screw Length—inches	32	40	56	72	96	128
No. Cylinder Sections	1	1	1	1	2	2
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Usual Motor Size, H. P.	7½-10	10-15	20-30	40-50	50-75	75-150
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Approx. Floor Dimensions—inches	40x98	48x112	60x120	84x132	96x156	104x192
Approx. Weight—lbs. (less Drive)	3200	3600	4800	6600	9600	12500

**Extruders are modified to meet requirements for a particular process*

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Whether you sell the Handyman tool board as a complete set of matched tools or with a partial selection of tools to the man who is outfitting his workshop "a tool at a time from the Handyman line," you can be sure of high profits and satisfied customers.

Handyman tools are an outstanding example of the competitively-priced, high-quality merchandise that moves faster from dealers' shelves, thanks to the eye-catching color and durability of Hercules plastics.

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Cellulose Products Department

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